Fundamentals of Cancer Biology

Book · May 2023

CITATION
1

READS
11,863

1 author:

Kousik Saravana
Lithuanian University of Health Sciences
7 PUBLICATIONS **1** CITATION

SEE PROFILE

FUNDAMENTALS OF CANCER BIOLOGY

S. KOUSIK SARAVANA

Abhayam Publishers

No.19, First street, AKG Nagar , Uppilipalayam,

Coimbatore ,Tamil Nadu , India

Fundamentals of cancer biology

Author : S.Kousik Saravana

E mail : skoushik122002@gmail.com

Published by

Abhayam Publishers

No.19, first street, AKG Nagar , Uppilipalayam,Coimbatore

,Tamilnadu , India

ISBN 978-81-959205-0-1

MRP :Rs 350

Acknowledgment

I thank the Almighty for creating the wisdom, space, and time.

I thank my family for the space and time. I acknowledge our Doctors and Professor Who have sown the laws and thought of Medical science in my minds and heart

My special thanks to Dr.V.Dooslin Mercy Bai and Dr.R.V.Shalini for supporting me and encouraging my work

And, I thank my Institution, Health care centre and university who helped me to cohere the idea which is sown in this book

Disclaimer

Care has been taken to confirm the accuracy of information presented in this book. The Author and the Publisher, However, Cannot accept any responsibility for errors or omission or for consequences from Application, Diagnoses and Treatment of the information in this book and make no warranty, express or implied, with respect to this contents

PREFACE

Cancer is a complex and multifaceted disease that affects millions of people worldwide. It is one of the leading causes of death globally, accounting for approximately 10 million deaths each year. The study of cancer biology is critical to understanding the underlying mechanisms of the disease and developing effective treatments.

The Fundamentals of Cancer Biology provides an essential introduction to the biology of cancer. It covers the basic principles of cell biology and genetics, the molecular mechanisms that contribute to cancer development and progression, and the various factors that influence the growth and spread of cancer cells.

This book also explores the different types of cancer and their unique characteristics, as well as the major risk factors associated with the disease. It delves into the role of the immune system in cancer and the use of immunotherapy in cancer treatment. In addition, the Fundamentals of Cancer Biology examines the current approaches to cancer diagnosis, including imaging and molecular techniques, and the various treatments available, such as surgery, radiation therapy, and chemotherapy. It also covers emerging therapies, including targeted therapy and gene therapy, and the challenges associated with drug resistance.

This book is designed for students and researchers in the fields of biology, medicine, and oncology, as well as anyone interested in gaining a deeper understanding of cancer biology. It provides a comprehensive overview of the field and serves as a foundation for further study and research.

Finally, The Fundamentals of Cancer Biology is an invaluable resource for anyone seeking to understand the complexities of cancer and the ongoing efforts to combat this devastating disease.

Keep reading

The Author

S. Kousik Saravana [UG-Student , Department of B-Medical , Sri Shakthi Institutions-L&T By-pass,Sri Shakthi Nagar Post, Sri Shakthi University, Chinniyampalayam, Coimbatore,Tamil Nadu 641062]

Email: skoushik122002@gmail.com

Contact no : 9843331284

MY SPECIAL THANKS TO

Prof. Dr VISWANATHAN SETHURAMAN

FRCS-General Surgery, MD -Obstetrics & Gynaecology, DGO, FRCS, FMA

PhD -Yoga,PG-Diploma in Psyco Neurobics & Memory Development

Medical Director ZI Clinic

Former Prof | HOD OF OBG &MEDICAL superintendent |Founder Director Centre for Yoga Studies, Annamalai University

PRASIDDHA VISHNUSANKAR M.Sc IT

FOUNDER-CEO AIMS ACADEMY | DIRECTOR – ARCOMM POLLACHI

RAJEEV GNANAVEL

Bsc (Hons). Agriculture

FOUNDER – CEO COAT SUIT VIVASAYI

Faculty of Agriculture ,Annamalai University,

Annamalai nagar, chidambaram – 608002

TABLE OF CONTENTS

CHAPTER 1

OVERVIEW OF CANCER BIOLOGY

1.1 INTRODUCTION

Cancer is a complex and multifaceted disease that affects millions of people worldwide. It is characterized by the uncontrolled growth and spread of abnormal cells in the body, which can lead to the formation of tumors and the invasion of surrounding tissues. Cancer can occur in any part of the body and can affect people of all ages, although the risk increases with age.The study of cancer biology is critical to understanding the underlying mechanisms of the disease and developing effective treatments. Cancer biology encompasses a wide range of topics, including the basic principles of cell biology and genetics, the molecular mechanisms that contribute to cancer development and progression, and the various factors that influence the growth and spread of cancer cells.

One of the key features of cancer cells is their ability to evade the normal controls that regulate cell growth and division. Normal cells divide in a controlled manner, with the timing and frequency of cell division tightly regulated by a complex network of signaling pathways. In contrast, cancer cells have acquired mutations in the genes that regulate these pathways, allowing them to bypass these controls and divide uncontrollably.

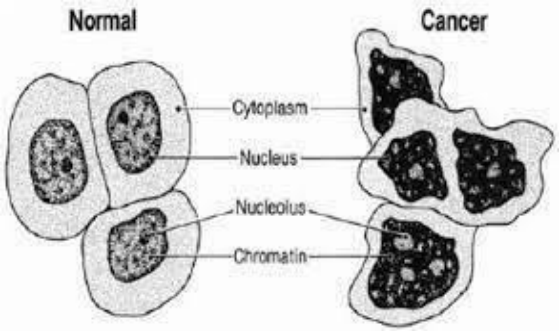

FIGURE:01

One of the most common mutations found in cancer cells is in the tumor suppressor genes, which normally act as a brake on cell division. When

these genes are mutated, the brakes are released, allowing cells to divide and proliferate unchecked. Mutations in other genes that control cell growth, such as oncogenes, can also contribute to the development of cancer.In addition to these genetic mutations, cancer cells also have altered metabolism and signaling pathways that enable them to survive and proliferate in hostile environments. Cancer cells often have a high demand for energy and nutrients, and they can alter their metabolism to meet these demands. For example, many cancer cells have a preference for glycolysis, a process that generates energy in the absence of oxygen, even when oxygen is available.

Cancer cells can also alter their signaling pathways to promote cell survival and proliferation. For example, they may activate the PI3K/Akt/mTOR pathway, which is involved in cell growth and metabolism, or the Ras/MAPK pathway, which is involved in cell proliferation and survival. These pathways can be targeted by drugs to slow or stop cancer growth.

The development and progression of cancer is also influenced by a wide range of external factors, including environmental exposures, lifestyle factors, and underlying medical conditions. Exposure to carcinogens, such as tobacco smoke, radiation, and certain chemicals, can increase the risk of cancer. Lifestyle factors, such as diet, exercise, and alcohol consumption, can also affect cancer risk.

One of the most important external factors influencing cancer development is the immune system. The immune system plays a critical role in recognizing and eliminating cancer cells, and defects in the immune system can increase the risk of cancer. In addition, some cancers can suppress the immune system or evade immune detection, allowing them to grow and spread.

The study of cancer biology is important not only for understanding the underlying mechanisms of the disease but also for developing effective treatments. Cancer treatments typically aim to target the unique features of cancer cells while sparing normal cells, and they can include surgery, radiation therapy, chemotherapy, and targeted therapy.

Surgery is often the first line of treatment for solid tumors, and it involves removing the cancerous tissue. Radiation therapy uses high-energy radiation to kill cancer cells or prevent their growth, and it can be delivered externally

or internally. Chemotherapy involves using drugs to kill cancer cells, and it can be administered orally or intravenously. Targeted therapy uses drugs that target specific molecular pathways involved in cancer growth and proliferation.

In recent years, there has been a growing interest in immunotherapy, which involves using the immune system to fight cancer. Immunotherapy can take several forms, including checkpoint inhibitors, which target proteins on immune cells that inhibit their activity, and adoptive cell therapy

1.2 ETIOLOGY OF CANCER

Etiology is the study of the causes or origins of a disease or medical condition. It involves the investigation of the various factors that contribute to the development and progression of the disease. The term is commonly used in medical and scientific fields to describe the underlying causes of a particular condition, and is often used interchangeably with the term "pathogenesis". Understanding the etiology of a disease is important for the development of effective treatment and prevention strategies. Factors that may be considered in the etiology of a disease include genetic, environmental, and lifestyle factors.

The etiology of cancer refers to the various factors that contribute to the development and progression of the disease. Cancer is a complex and multifaceted disease, and its etiology involves a wide range of genetic, environmental, and lifestyle factors.

Genetic factors

Genetic mutations are one of the most important factors in the etiology of cancer. Mutations in specific genes can disrupt the normal cellular processes that regulate cell growth and division, leading to the uncontrolled proliferation of cells. These mutations can be inherited or acquired through exposure to various environmental factors.

Inherited mutations in specific genes, such as BRCA1 and BRCA2, are associated with an increased risk of developing breast and ovarian cancer. Similarly, mutations in the TP53 gene, which is involved in DNA repair and

cell cycle regulation, can increase the risk of developing several types of cancer, including breast, colon, and lung cancer.

Acquired mutations can also contribute to cancer development. Exposure to environmental factors, such as tobacco smoke, radiation, and certain chemicals, can damage DNA and lead to mutations. In addition, errors during DNA replication or repair can also result in mutations.

Environmental factors

Environmental factors can play a significant role in the development of cancer. Exposure to certain substances, such as tobacco smoke, alcohol, and certain chemicals, can increase the risk of cancer development. For example, smoking is a major risk factor for lung cancer, while alcohol consumption is a risk factor for liver cancer.

Exposure to ionizing radiation, such as X-rays and gamma rays, can also increase the risk of cancer. This type of radiation can damage DNA and lead to mutations, which can contribute to cancer development. People who work in occupations that involve exposure to radiation, such as nuclear workers and radiologists, are at increased risk of developing cancer.

Other environmental factors that may increase the risk of cancer include air pollution, water pollution, and exposure to certain viruses and bacteria. For example, the human papillomavirus (HPV) is associated with an increased risk of cervical cancer, while the hepatitis B and C viruses are associated with an increased risk of liver cancer.

Lifestyle factors

Lifestyle factors, such as diet, physical activity, and body weight, can also influence the development of cancer. A diet high in red and processed meats, for example, has been linked to an increased risk of colorectal cancer. In contrast, a diet high in fruits, vegetables, and whole grains may reduce the risk of several types of cancer.Physical activity is also important for reducing the risk of cancer. Regular exercise can help maintain a healthy body weight and reduce inflammation, both of which are associated with a lower risk of cancer. In addition, physical activity may help reduce the risk of several types of cancer, including breast, colon, and prostate cancer.

Body weight is also an important factor in the etiology of cancer. Obesity is associated with an increased risk of several types of cancer, including breast, colon, and kidney cancer. This may be due in part to the fact that obesity can lead to chronic inflammation and insulin resistance, both of which are associated with an increased risk of cancer.

Other lifestyle factors that may increase the risk of cancer include alcohol consumption, tobacco use, and exposure to sunlight. Excessive alcohol consumption is associated with an increased risk of several types of cancer, including breast, liver, and esophageal cancer. Tobacco use is a major risk factor for several types of cancer, including lung, bladder, and pancreatic cancer. Exposure to sunlight can also increase the risk of skin cancer, particularly if sunburns are frequent or severe.In conclusion, the etiology of cancer is complex and multifaceted, involving a wide range of genetic, environmental, and lifestyle factors. Understanding these factors is critical for developing effective strategies for cancer prevention and treatment

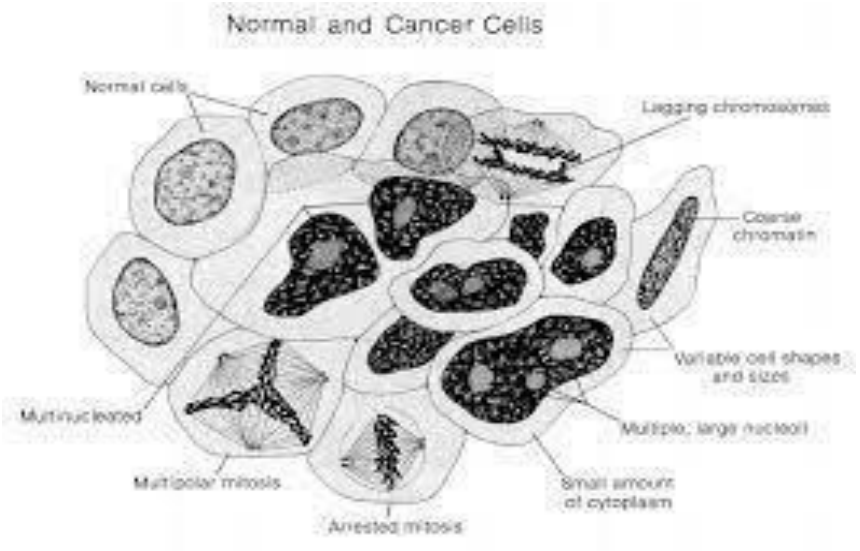

FIGURE : 02

1.3 TYPES OF CANCER

Cancer is a group of diseases characterized by uncontrolled growth and spread of abnormal cells in the body. There are many types of cancer, each of which can affect different organs and tissues in the body. Some of the most common types of cancer include:

Breast cancer:

Breast cancer is the most common cancer among women worldwide. It develops in the breast tissue and can be detected through mammograms, self-exams, and other screening methods. Risk factors for breast cancer include genetics, age, and lifestyle factors such as alcohol consumption and obesity.

Lung cancer:

Lung cancer is the leading cause of cancer-related deaths in both men and women worldwide. It is often caused by long-term exposure to tobacco smoke, and other risk factors include exposure to radon and air pollution. Symptoms of lung cancer can include coughing, chest pain, and shortness of breath.

Prostate cancer:

Prostate cancer is the most common cancer among men in the United States. It develops in the prostate gland, which is a small gland in the male reproductive system. Risk factors for prostate cancer include age, family history, and certain genetic mutations. Symptoms of prostate cancer may include difficulty urinating, blood in the urine, and erectile dysfunction.

Colorectal cancer:

Colorectal cancer develops in the colon or rectum, which are parts of the digestive system. It is the third most common cancer in both men and women in the United States. Risk factors for colorectal cancer include age, family history, and lifestyle factors such as a diet high in red meat and low in fiber. Symptoms of colorectal cancer may include changes in bowel habits, abdominal pain, and rectal bleeding.

Skin cancer:

Skin cancer is the most common type of cancer in the United States. It develops in the cells that make up the skin and can be caused by exposure to ultraviolet (UV) radiation from the sun or tanning beds. Risk factors for skin cancer include fair skin, a history of sunburns, and a family history of the disease. Symptoms of skin cancer may include changes in the appearance of moles or other skin lesions.

Bladder cancer:

Bladder cancer develops in the bladder, which is a hollow organ in the lower abdomen that stores urine. Risk factors for bladder cancer include age, smoking, exposure to certain chemicals, and a history of bladder infections. Symptoms of bladder cancer may include blood in the urine, pain during urination, and frequent urination.

Leukemia:

Leukemia is a type of cancer that develops in the blood and bone marrow, which are the tissues that produce blood cells. There are several types of leukemia, each of which affects different types of blood cells. Risk factors for leukemia include exposure to radiation and certain chemicals, as well as certain genetic mutations. Symptoms of leukemia may include fatigue, fever, and easy bruising or bleeding.

Lymphoma:

Lymphoma is a type of cancer that develops in the lymphatic system, which is part of the immune system. There are several types of lymphoma, each of which affects different types of immune cells. Risk factors for lymphoma include exposure to certain chemicals and infections with certain viruses. Symptoms of lymphoma may include swollen lymph nodes, fatigue, and unexplained weight loss.

Pancreatic cancer:

Pancreatic cancer develops in the pancreas, which is a gland in the abdomen that produces digestive enzymes and hormones. It is one of the deadliest types of cancer, with a low survival rate. Risk factors for pancreatic cancer include age, smoking, and certain genetic mutations. Symptoms of pancreatic cancer may include abdominal pain, jaundice, and weight loss.

there are many types of cancer that can affect different organs and tissues in the body

1.4 ANATOMY OF CANCER CELLS

Cancer is a complex disease that can affect any part of the body. It starts when cells in a specific tissue or organ grow abnormally and divide out of control, forming a mass or tumor. The tumor can be benign (non-cancerous) or malignant (cancerous).

The structure of cancer can vary depending on the type and stage of the disease. In general, cancer cells have abnormal features that distinguish them from normal cells. These features can include changes in cell size and shape, loss of specialized cell functions, and alterations in the way cells communicate with each other.

As cancer cells continue to divide and grow, they can invade nearby tissues and organs, and spread to other parts of the body through the bloodstream or lymphatic system. This process is called metastasis and can lead to the formation of secondary tumors in other parts of the body.

The structure of a cancerous tumor also includes a microenvironment composed of blood vessels, immune cells, and other types of cells that support tumor growth and survival. This microenvironment can play a crucial role in the progression and response of the tumor to treatment.

Overall, the structure of cancer is complex and dynamic, with changes occurring at the cellular and molecular levels as the disease progresses. Understanding the structure and behavior of cancer cells is crucial for developing effective treatments and improving outcomes for patients with cancer

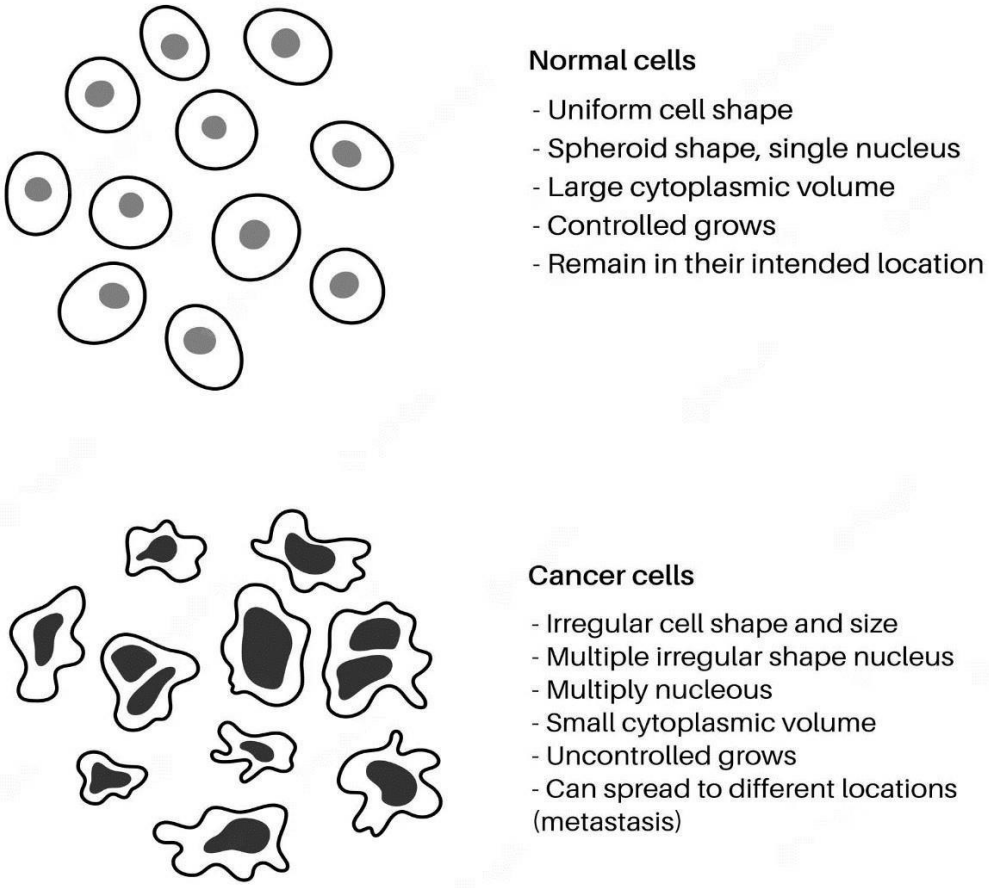

FIGURE:03

1.5 HISTOPATHOLOGY OF CANCER

Histopathology is the study of the microscopic features of diseased tissues. It is an essential tool in the diagnosis and management of cancer. Histopathology allows pathologists to examine the structure of cancer cells and tissues and determine the extent and severity of the disease.

In the case of cancer, histopathology involves the examination of tissue samples taken from the tumor and surrounding areas. These samples are typically obtained through a biopsy or surgical resection. The pathologist examines these samples under a microscope and looks for changes in the

cells and tissues that are indicative of cancer. The pathologist may also perform additional tests to identify specific molecular markers that can help with diagnosis and treatment planning.

One of the key features of cancer that can be seen on histopathology is the presence of abnormal cells. Cancer cells often have an abnormal shape and size, and may have features such as enlarged nuclei, increased mitotic activity (indicating rapid cell division), and loss of cell differentiation (meaning the cells no longer resemble normal cells of the tissue they came from). These changes can be used to classify the tumor as a specific type of cancer and determine its grade, which is a measure of how abnormal the cells appear.

There are many different types of cancer, each with its own distinct histopathological features. Some of the most common types of cancer include:

Carcinoma: This type of cancer arises from cells in the epithelial tissue, which is the lining of the body's internal and external surfaces. Carcinomas can occur in many different organs, including the lungs, breast, prostate, and colon. Histopathological features of carcinomas may include the presence of glandular structures, the formation of solid nests or sheets of cells, and the appearance of keratinized cells (in some cases).

Sarcoma: This type of cancer arises from cells in the mesenchymal tissue, which includes bone, muscle, and connective tissue. Sarcomas can occur in many different parts of the body, including the bones, soft tissues, and organs such as the uterus. Histopathological features of sarcomas may include the presence of spindle-shaped cells, the formation of cartilage or bone-like structures, and the appearance of large, pleomorphic cells (in some cases).

Leukemia and lymphoma: These types of cancer arise from cells in the blood or lymphatic system. Leukemias are cancers of the white blood cells, while lymphomas are cancers of the lymphatic system. Histopathological features of these types of cancer may include the presence of abnormal cells in the blood or lymph nodes, respectively.

Histopathology can also be used to determine the extent of cancer spread, or metastasis. Pathologists look for evidence of cancer cells in nearby tissues

and lymph nodes, which can indicate the likelihood of the cancer spreading to other parts of the body. In addition, histopathology can be used to examine tissue samples from other parts of the body to look for evidence of secondary tumors, which can indicate that the cancer has spread.

In some cases, histopathology can also provide information about the prognosis (expected outcome) of the cancer. For example, certain molecular markers may be associated with a better or worse prognosis, which can help guide treatment decisions. In addition, the stage of the cancer (which is based on the size and extent of the tumor, as well as the presence or absence of metastasis) can also provide important prognostic information.

Histopathology is an essential tool in the diagnosis and management of cancer. It allows pathologists to examine the structure of cancer cells and tissues in detail, providing information about the type, grade, and extent of the disease. This information can help guide treatment decisions and provide important prognostic information for patients. In addition, ongoing

CHAPTER 2

CANCER METASTASIS

2.1 INTRODUCTION

Cancer metastasis is the process by which cancer cells spread from the site of origin to other parts of the body. It is a complex and multifactorial process that involves many different steps, including the invasion of surrounding tissues, the entry into the bloodstream or lymphatic system, and the colonization of distant organs.

Metastasis is a major cause of cancer-related deaths, as it often occurs after the cancer has already spread and become difficult to treat. Understanding the mechanisms underlying cancer metastasis is therefore essential for the development of new and effective cancer therapies.

Mechanisms of Cancer Metastasis

The metastatic process is a multi-step process that involves the interaction of cancer cells with the surrounding tissue microenvironment. The first step in this process is the invasion of surrounding tissues by cancer cells. This involves the degradation of the extracellular matrix (ECM) by enzymes such as matrix metalloproteinases (MMPs) and cathepsins, which allows cancer cells to penetrate into nearby tissues.

Once cancer cells have invaded surrounding tissues, they may enter the bloodstream or lymphatic system. This process is facilitated by the secretion of chemokines and growth factors by cancer cells, which attract blood vessels and lymphatic vessels to the site of the tumor. Cancer cells may also hijack the normal processes of angiogenesis (the formation of new blood vessels) and lymphangiogenesis (the formation of new lymphatic vessels) to promote their own growth and spread.

Once cancer cells enter the bloodstream or lymphatic system, they are carried to distant organs. The process of metastasis is not random, and certain organs are more likely to be targeted by specific types of cancer. For

example, breast cancer often metastasizes to the lungs, liver, and bones, while prostate cancer often metastasizes to the bones.

Upon arrival at a distant organ, cancer cells may encounter a hostile microenvironment. This microenvironment may include a lack of appropriate nutrients, oxygen, or growth factors, as well as an immune response from the host organism. Cancer cells that are able to survive and adapt to this new microenvironment may then begin to proliferate and form secondary tumors.

Factors Influencing Cancer Metastasis

The metastatic process is influenced by many different factors, both intrinsic (related to the cancer cells themselves) and extrinsic (related to the surrounding tissue microenvironment).

Intrinsic factors that can influence cancer metastasis include the genetic and epigenetic alterations that occur in cancer cells. These alterations may affect the expression of genes involved in the regulation of cell adhesion, migration, and invasion. For example, mutations in the tumor suppressor gene TP53 are commonly found in many different types of cancer, and are associated with increased metastatic potential.

Extrinsic factors that can influence cancer metastasis include the composition and structure of the surrounding tissue microenvironment. For example, the presence of certain cell types, such as cancer-associated fibroblasts, immune cells, and endothelial cells, can promote or inhibit cancer metastasis. In addition, factors such as hypoxia (low oxygen levels) and inflammation can also promote cancer metastasis by altering the expression of genes involved in cell adhesion, migration, and invasion.

Clinical Implications of Cancer Metastasis

The ability of cancer cells to metastasize is a major challenge in the treatment of cancer. Metastasis often occurs after the cancer has already spread, making it difficult to treat with conventional therapies such as surgery, chemotherapy, and radiation therapy.

There are currently several strategies for preventing or treating cancer metastasis. One approach is to target the molecular pathways involved in the metastatic process. For example, drugs that target angiogenesis, such as

bevacizumab, have been developed to prevent the formation of new blood vessels and inhibit the growth of tumors.

2.2 HISTORY OF METASTASIS

The concept of cancer metastasis has been recognized for centuries, although our understanding of the underlying mechanisms has evolved considerably over time. This article will provide a brief overview of the history of metastasis, from its early recognition to current research on its mechanisms and treatment.

Ancient Times

The earliest written record of cancer dates back to ancient Egypt, where a description of breast cancer was found in the Edwin Smith papyrus, dated around 1600 BC. However, there is little evidence of an understanding of cancer metastasis in ancient times. In fact, many ancient medical theories held that cancer was caused by an excess of black bile or other bodily fluids, and that cancerous tumors were self-contained growths that did not spread to other parts of the body.

Hippocrates and Galen

The ancient Greek physician Hippocrates (460-370 BC) is often credited with the first recognition of cancer metastasis. He observed that tumors could recur in different parts of the body after surgical removal, and hypothesized that this was due to the spread of cancerous cells throughout the body. His observations were later expanded upon by the Roman physician Galen (130-200 AD), who described the spread of breast cancer to the liver and other organs.

Renaissance and Enlightenment

During the Renaissance and Enlightenment periods, there was a renewed interest in the study of anatomy and physiology, and the first anatomical descriptions of metastatic cancer were published. In 1665, the English physician Thomas Bartholin described the spread of cancer from the breast to the axillary lymph nodes, and in 1679, the Italian physician Giovanni Maria Lancisi described the spread of cancer from the colon to the liver.

18th and 19th Centuries

In the 18th and 19th centuries, there was a growing understanding of the cellular basis of cancer, and the first histological descriptions of metastatic tumors were made. In 1811, the French physician René Laennec described the microscopic features of lung cancer, including the presence of tumor cells in the lymphatic vessels. In 1829, the German pathologist Johannes Müller described the microscopic features of metastatic tumors in the liver, and in 1867, the English surgeon Stephen Paget proposed the "seed and soil" hypothesis of metastasis, which suggested that certain cancers had a predilection for specific organs.

20th Century

The 20th century saw a rapid expansion of knowledge about the mechanisms of cancer metastasis, including the role of the immune system, the cellular and molecular mechanisms of invasion and migration, and the molecular pathways that regulate metastatic behavior.

In the early 1900s, the German pathologist Paul Ehrlich proposed the theory of "tumor immunology," which suggested that the immune system played a role in recognizing and eliminating cancer cells. This theory was later expanded upon by the American immunologist Lloyd Old, who proposed the concept of "cancer immunosurveillance," which suggested that the immune system was constantly monitoring the body for cancer cells and eliminating them before they could form tumors.

In the mid-1900s, there was a growing interest in the cellular and molecular mechanisms of cancer metastasis. In 1953, the American pathologist James Ewing described the "Ewing effect," which suggested that the growth of metastatic tumors was dependent on the interaction between cancer cells and the surrounding tissue microenvironment. In 1969, the American cell biologist Elizabeth Hay described the process of "cellular locomotion," which explained how cancer cells could migrate through tissues and invade other organs.

The Modern Era

In the 19th and early 20th centuries, advances in microscopy and histology allowed researchers to study the structure and behavior of cancer cells in more detail. Rudolf Virchow, a German physician and pathologist, was among the first to use the microscope to study cancer cells. He observed that cancer cells often had an irregular shape and size, and that they tended to be more invasive than normal cells.

In the early 20th century, researchers began to develop animal models of cancer metastasis. In 1906, the American physician James Ewing developed a mouse model of cancer metastasis by injecting cancer cells into the tail vein of mice. This model allowed researchers to study the spread of cancer cells throughout the body in a controlled setting.

In the mid-20th century, advances in genetics and molecular biology revolutionized our understanding of cancer metastasis. In the 1950s, the British physician and scientist Peter Nowell proposed the concept of clonal evolution, which suggested that cancer cells evolved over time through a process of mutation and selection. This concept provided a framework for understanding the genetic changes that occur during cancer metastasis.

In the 1960s and 1970s, researchers began to study the molecular mechanisms underlying cancer metastasis in more detail. They identified a number of genes and signaling pathways that were involved in the invasion and spread of cancer cells, including matrix metalloproteinases (MMPs), vascular endothelial growth factor (VEGF), and epidermal growth factor receptor (EGFR).

In the 1980s and 1990s, advances in imaging technologies allowed researchers to visualize cancer cells and tumors in living organisms. Techniques such as computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET) became widely used in clinical practice, allowing doctors to detect and monitor cancer metastasis in patients.

Recent Advances

In the 21st century, researchers have continued to make significant advances in our understanding of cancer metastasis. The development of new imaging techniques, such as multiphoton microscopy

2.3 SEQUENTIAL STEPS OF METASTASIS

Metastasis is a complex and multistep process that involves the dissemination of cancer cells from the primary tumor to distant organs. The process of metastasis can be broken down into several sequential steps, each of which is essential for the successful spread of cancer cells throughout the body.

Step 1: Invasion

The first step in metastasis is the invasion of cancer cells into surrounding tissues. Cancer cells are able to invade surrounding tissues by breaking down the extracellular matrix (ECM), which is a complex network of proteins that provides structural support to tissues. Cancer cells secrete enzymes such as matrix metalloproteinases (MMPs) that can degrade the ECM, allowing them to penetrate into adjacent tissues.

Step 2: Intravasation

After invading surrounding tissues, cancer cells can enter into blood or lymphatic vessels in a process called intravasation. This is facilitated by the ability of cancer cells to break down the basement membrane, a specialized ECM that lines blood and lymphatic vessels. Once inside the vessels, cancer cells can be carried to distant organs.

Step 3: Circulation

Once in the bloodstream or lymphatic vessels, cancer cells can travel to distant organs. However, the majority of circulating cancer cells are eliminated by the immune system or become trapped in capillaries, and only a small fraction of cells are able to survive and colonize distant organs.

Step 4: Extravasation

To establish a secondary tumor, cancer cells must be able to exit the bloodstream or lymphatic vessels and invade into the surrounding tissue. This process is known as extravasation and is facilitated by the ability of cancer cells to adhere to the endothelial cells that line blood vessels. Cancer cells can also use MMPs to break down the basement membrane and enter the surrounding tissue.

Step 5: Colonization

Once cancer cells have extravasated into a distant organ, they must be able to survive and establish a secondary tumor. This process, called colonization, is facilitated by interactions between cancer cells and the surrounding tissue. Cancer cells can secrete growth factors that stimulate the growth of blood vessels, which in turn supply the tumor with nutrients and oxygen.

Step 6: Growth and Progression

After colonization, the secondary tumor can continue to grow and progress. This can be facilitated by the ability of cancer cells to evade the immune system and to acquire additional genetic mutations that confer a growth advantage. The growth and progression of the secondary tumor can lead to further invasion, intravasation, circulation, and colonization, perpetuating the cycle of metastasis.

The process of metastasis is a complex and multistep process that involves the dissemination of cancer cells from the primary tumor to distant organs. Each step of metastasis is essential for the successful spread of cancer cells, and understanding the underlying mechanisms of metastasis is essential for developing new treatments and improving patient outcomes.

2.4 STAGES OF METASTASIS

Metastasis is a complex process that involves the spread of cancer cells from the primary tumor to other parts of the body. This process is divided into several stages or steps, which are essential for the successful establishment of secondary tumors.

Local Invasion stage, cancer cells break away from the primary tumor and invade nearby tissues, such as lymph nodes or blood vessels. This process is facilitated by the ability of cancer cells to secrete enzymes that break down the extracellular matrix, which is a network of proteins that provides structural support to tissues. Once cancer cells invade nearby tissues, they can enter the bloodstream or lymphatic system.Once cancer cells have invaded nearby tissues, they can enter the bloodstream or lymphatic system, which allows them to travel to other parts of the body. This process is known as intravasation and is facilitated by the ability of cancer cells to break down the basement membrane, which is a specialized layer that separates the bloodstream or lymphatic system from surrounding tissues.Once cancer cells have entered the bloodstream or lymphatic system, they can travel to distant organs. However, the majority of circulating cancer cells are eliminated by the immune system, while others become trapped in capillaries. Only a small fraction of circulating cancer cells are able to survive and colonize distant organs.

To establish a secondary tumor, cancer cells must exit the bloodstream or lymphatic system and invade surrounding tissues. This process is known as extravasation and is facilitated by the ability of cancer cells to adhere to the endothelial cells that line blood vessels. Cancer cells can also use enzymes to break down the basement membrane and enter the surrounding tissue.Once cancer cells have extravasated into a distant organ, they must be able to survive and establish a secondary tumor. This process is known as colonization and is facilitated by interactions between cancer cells and the surrounding tissue. Cancer cells can secrete growth factors that stimulate the growth of blood vessels, which in turn supply the tumor with nutrients and oxygen., understanding the stages of metastasis is important for developing strategies to prevent or treat metastatic cancer. Researchers are working to identify key molecular mechanisms involved in each stage of metastasis, with the aim of developing new drugs that can target these mechanisms and prevent the spread of cancer cells. Early detection and

treatment of primary tumors can also help to prevent the development of metastasis.

CHAPTER 3

TUMOR FORMATION

3.1 UNCONTROLLED CELL DIVISION

Cancer is a complex disease characterized by uncontrolled cell division and the ability of cancer cells to invade and metastasize to distant organs. Normal cells in the body undergo a tightly regulated process of cell division, known as the cell cycle, which ensures that new cells are produced only when needed and that damaged or abnormal cells are eliminated. Cancer cells, on the other hand, have acquired mutations or alterations in key genes that control the cell cycle, leading to uncontrolled cell division and the formation of tumors.

The cell cycle is divided into several phases, including G1 (gap 1), S (DNA synthesis), G2 (gap 2), and M (mitosis). In G1 phase, cells undergo growth and metabolic activities to prepare for DNA replication in the S phase. In G2 phase, the cell undergoes further growth and prepares for cell division in the M phase. During mitosis, the cell divides into two daughter cells, each with a complete set of chromosomes.

Normal cells have several mechanisms to ensure that the cell cycle proceeds smoothly and that DNA damage or errors are repaired before cell division occurs. One of these mechanisms is the control of cyclin-dependent kinases (CDKs), which are enzymes that regulate the progression of the cell cycle by phosphorylating target proteins. CDK activity is tightly controlled by the levels of cyclins, which are proteins that bind to and activate CDKs at specific stages of the cell cycle.

In cancer cells, alterations in genes that regulate the cell cycle can lead to uncontrolled cell division and the formation of tumors. For example, mutations in the tumor suppressor gene TP53, which encodes the p53 protein, are commonly found in many types of cancer. The p53 protein plays a critical role in the cell cycle by activating DNA repair pathways or inducing cell death (apoptosis) in response to DNA damage. When p53 is

mutated or absent, cells with DNA damage can continue to divide, leading to the accumulation of mutations and the development of cancer.

Other genes that regulate the cell cycle, such as CDKs and cyclins, can also be altered in cancer cells. For example, the CDK inhibitor p16INK4a is frequently deleted or silenced in many types of cancer, leading to the uncontrolled activation of CDKs and the cell cycle. In addition, some cancer cells can produce their own growth factors, which stimulate cell division and promote tumor growth.

Uncontrolled cell division in cancer cells can also lead to the loss of normal cell functions and the acquisition of new characteristics, such as the ability to invade surrounding tissues and metastasize to distant organs. Cancer cells can undergo a process of epithelial-mesenchymal transition (EMT), which involves changes in gene expression that enable cells to detach from the primary tumor, invade surrounding tissues, and enter the bloodstream or lymphatic system.

During EMT, cancer cells undergo changes in cell shape and adhesion, and acquire the ability to degrade extracellular matrix proteins that normally provide structural support to tissues. In addition, EMT is associated with the acquisition of stem-like properties, such as self-renewal and resistance to chemotherapy and radiation therapy., uncontrolled cell division is a hallmark of cancer and is driven by alterations in genes that regulate the cell cycle and cell division. Understanding the molecular mechanisms that underlie these alterations is critical for developing new strategies to prevent or treat cancer. Researchers are actively studying the role of specific genes and proteins in the cell cycle and cell division, with the aim of developing targeted therapies that can selectively inhibit cancer cell growth and prevent the spread of cancer to other parts of the body.

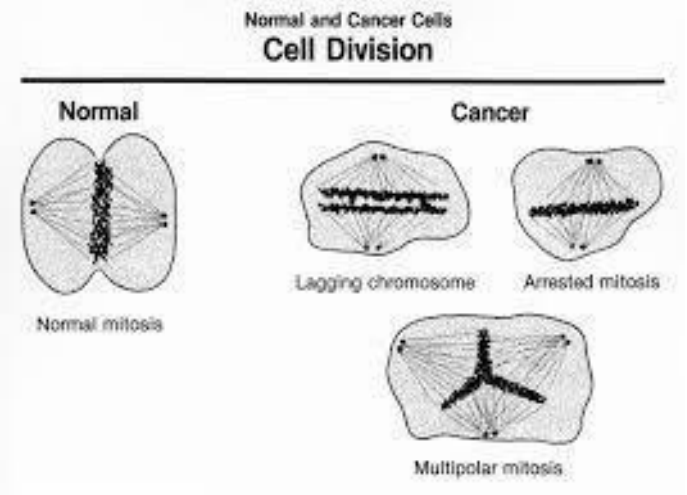

FIGURE:04

3.2 NEOANGIOGENESIS

Neoangiogenesis, also known as angiogenesis, is the process of formation of new blood vessels from pre-existing ones. This process is critical for normal development, wound healing, and tissue regeneration. However, neoangiogenesis is also a critical process in the growth and spread of cancer. In fact, angiogenesis is a hallmark of cancer, and tumor growth and progression depend on the ability of cancer cells to induce the formation of new blood vessels.

Angiogenesis is a complex process that involves a sequence of events that are tightly regulated by a balance between pro-angiogenic and anti-angiogenic factors. The process of angiogenesis begins with the activation of endothelial cells, which are the cells that line the interior surface of blood vessels. In response to pro-angiogenic signals, endothelial cells undergo changes in their shape and behavior, leading to the formation of new blood vessels.

In cancer, neoangiogenesis is a critical process that enables tumors to obtain oxygen and nutrients necessary for their growth and survival. Tumor cells secrete pro-angiogenic factors, such as vascular endothelial growth factor (VEGF) and basic fibroblast growth factor (bFGF), which stimulate the activation and proliferation of endothelial cells. Tumor cells also secrete matrix metalloproteinases (MMPs), which degrade the extracellular matrix (ECM) surrounding blood vessels, facilitating the migration of endothelial cells and the formation of new blood vessels.

Once activated, endothelial cells undergo a series of steps to form new blood vessels. These steps include the degradation of the basement membrane, migration of endothelial cells towards the tumor, proliferation of endothelial cells to form tubular structures, and recruitment of pericytes and smooth muscle cells to stabilize the new blood vessels.

The new blood vessels formed by neoangiogenesis in tumors are abnormal and dysfunctional. These blood vessels are highly permeable, allowing for the leakage of plasma proteins and red blood cells into the surrounding tissues, leading to the formation of edema and inflammation. The abnormal blood vessels in tumors are also tortuous and disorganized, leading to poor blood flow and hypoxia (low oxygen levels) in some areas of the tumor.

The role of neoangiogenesis in cancer is not limited to the growth and survival of tumors. Neoangiogenesis is also critical for the spread of cancer cells to distant organs, a process known as metastasis. Cancer cells that detach from the primary tumor and enter the bloodstream or lymphatic system require a blood supply to survive and proliferate in distant organs. These cancer cells can induce the formation of new blood vessels in the surrounding tissues, enabling them to establish secondary tumors in distant organs.

The formation of new blood vessels in tumors is a complex process that involves a balance between pro-angiogenic and anti-angiogenic factors. In addition to pro-angiogenic factors, there are also several anti-angiogenic factors that can inhibit neoangiogenesis in tumors. One of the best-known anti-angiogenic factors is endostatin, which is a fragment of collagen XVIII that inhibits the proliferation and migration of endothelial cells.

Several strategies have been developed to target neoangiogenesis in cancer as a way to inhibit tumor growth and metastasis. One approach is to directly target the pro-angiogenic factors secreted by tumor cells, such as VEGF and bFGF. Drugs that target VEGF, such as bevacizumab, have been approved for the treatment of several types of cancer, including colorectal, lung, and kidney cancer.

Another approach to target neoangiogenesis in cancer is to target the endothelial cells themselves. Several drugs have been developed that target the receptors on endothelial cells that are involved in angiogenesis, such as the VEGF receptor and the platelet-derived growth

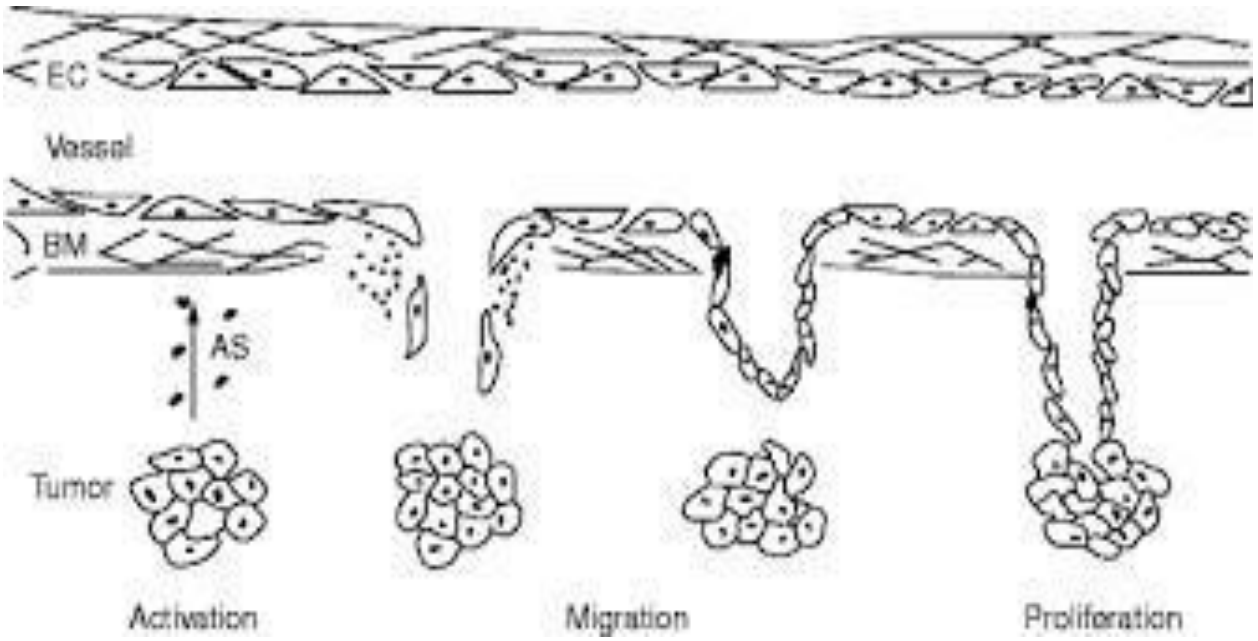

FIGURE:05

3.3 PRIMARY TUMOR GROWTH

Primary tumor growth refers to the uncontrolled proliferation of cancerous cells at the site of origin. This process is the result of numerous genetic and epigenetic alterations that have occurred in the cells, leading to their uncontrolled growth and division. In the early stages of tumor growth, the tumor cells remain confined to the original site, and the tumor is said to be localized. However, as the tumor continues to grow, it can invade and destroy nearby tissues and organs.

The growth of the primary tumor is influenced by numerous factors, including the type of cancer, the stage of the disease, and the patient's overall health. In general, cancer cells grow and divide more rapidly than normal cells, which means that the primary tumor can grow quite quickly. However, the rate of growth varies from tumor to tumor and can be influenced by factors such as the tumor's blood supply, the presence of hormones or growth factors, and the immune response to the tumor.

The process of primary tumor growth involves a complex interplay of cellular and molecular events, including alterations in signaling pathways, changes in gene expression, and the development of new blood vessels to supply nutrients and oxygen to the growing tumor. One critical aspect of tumor growth is the ability of cancer cells to evade the normal mechanisms that regulate cell growth and division. This evasion can occur through numerous mechanisms, including mutations in genes that regulate cell cycle progression, the loss of tumor suppressor genes, and alterations in signaling pathways that control cell survival and proliferation.

In addition to these intrinsic factors, the growth of the primary tumor can also be influenced by the surrounding microenvironment. Tumor cells can alter their surrounding environment, releasing molecules that promote angiogenesis, recruiting immune cells to the site of the tumor, and modifying the extracellular matrix to facilitate invasion and migration. Additionally, tumor-associated fibroblasts and immune cells can secrete factors that promote tumor growth and survival.As the primary tumor continues to grow, it can eventually invade nearby tissues and organs. The ability of cancer cells to invade and migrate is influenced by numerous factors, including alterations in signaling pathways that regulate cell motility and adhesion, changes in gene expression, and modifications of the extracellular matrix. Cancer cells can also secrete enzymes that degrade the extracellular matrix, allowing them to migrate through tissues and invade adjacent structures. the growth of the primary tumor is a complex process that involves numerous genetic, epigenetic, and environmental factors. Despite our growing understanding of the molecular and cellular mechanisms that drive tumor growth, there is still much that we do not know about this process. By better understanding the factors that influence primary tumor growth, researchers may be able to develop new treatments that target these processes and help to prevent the spread of cancer to other parts of the body

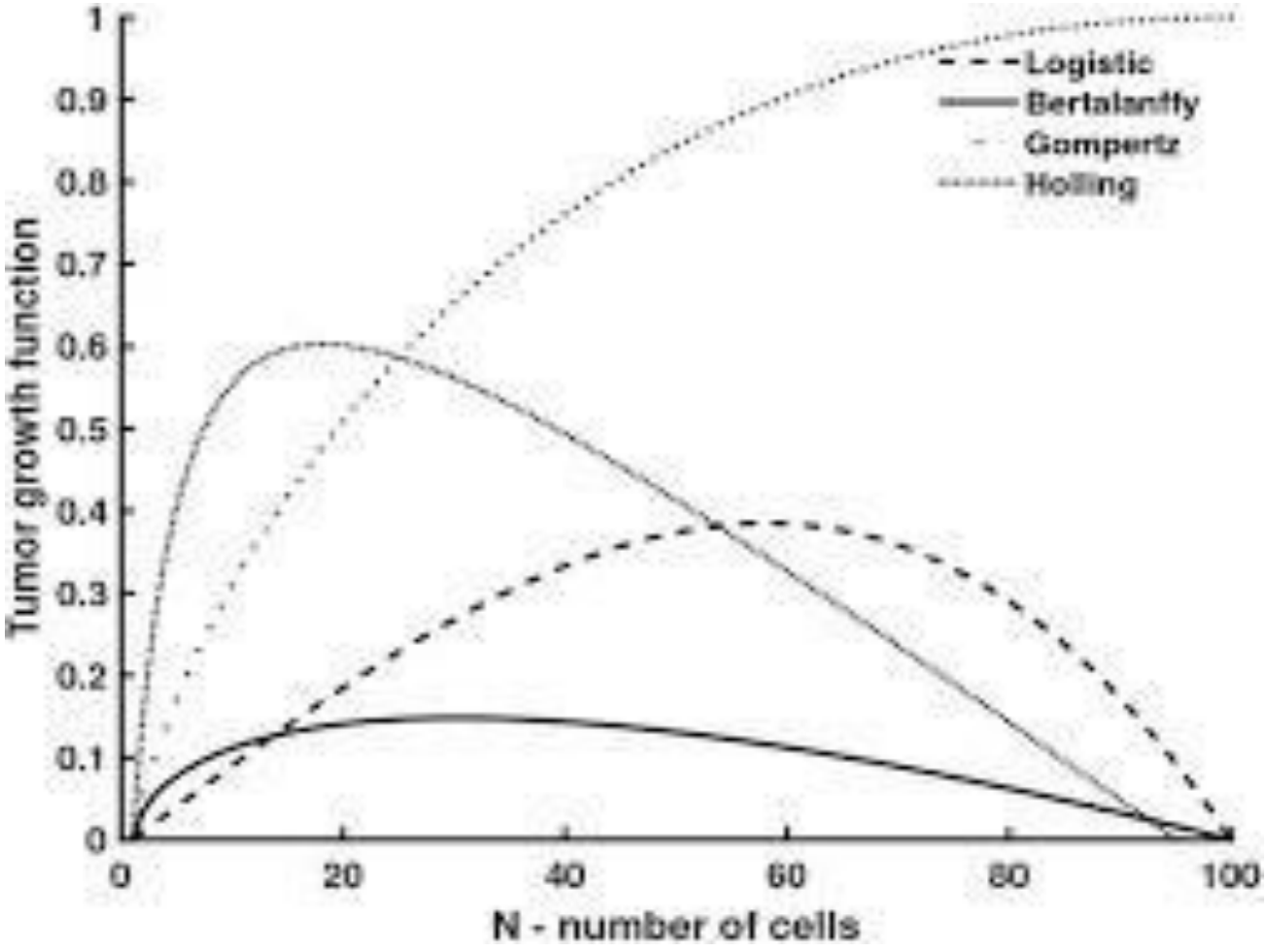
Logistic
Bertalanffy
Gompertz
Holling
Tumor growth function
N - number of cells
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100

FIGURE:06

CHAPTER 4

AVOIDANCE OF CELL DEALTH

4.1 APOPTOSIS

Apoptosis, also known as programmed cell death, is a fundamental process in multicellular organisms that plays a critical role in development, homeostasis, and disease. The term "apoptosis" was first coined in 1972 by Kerr, Wyllie, and Currie to describe a distinctive form of cell death that was different from necrosis. Since then, numerous studies have identified the molecular and cellular mechanisms that regulate apoptosis, leading to a deeper understanding of this process and its role in health and disease.

Overview of Apoptosis:

Apoptosis is a highly regulated form of cell death that is characterized by distinct morphological changes, including chromatin condensation, nuclear fragmentation, and formation of apoptotic bodies. These changes are accompanied by biochemical alterations, including activation of caspases, cleavage of DNA, and externalization of phosphatidylserine. Apoptosis can be triggered by a variety of stimuli, including developmental cues, DNA damage, oxidative stress, and activation of death receptors.

The regulation of apoptosis is a complex process that involves a network of signaling pathways and molecular interactions. In general, apoptotic signaling can be divided into two main pathways: the intrinsic pathway and the extrinsic pathway. The intrinsic pathway is activated by internal stimuli, such as DNA damage or cellular stress, while the extrinsic pathway is triggered by external signals, such as cytokines or death ligands.

The Intrinsic Pathway:

The intrinsic pathway of apoptosis is regulated by the Bcl-2 family of proteins, which are located in the mitochondria and regulate the release of cytochrome c. The Bcl-2 family is composed of both pro-apoptotic and anti-apoptotic members. The pro-apoptotic members, such as Bax and Bak, promote the release of cytochrome c from the mitochondria, while the anti-

apoptotic members, such as Bcl-2 and Bcl-XL, prevent cytochrome c release and promote cell survival.

The release of cytochrome c from the mitochondria leads to the activation of caspases, a family of cysteine proteases that cleave specific substrates and ultimately lead to the execution of apoptosis. The activation of caspases occurs through a complex cascade of events that involves the formation of the apoptosome, a multimeric complex composed of cytochrome c, Apaf-1, and caspase-9.

The Extrinsic Pathway:

The extrinsic pathway of apoptosis is initiated by the binding of death ligands, such as Fas ligand or tumor necrosis factor-alpha (TNF-alpha), to death receptors on the cell surface. The binding of these ligands leads to the recruitment of adapter proteins, such as FADD, which in turn recruit and activate caspase-8. The activation of caspase-8 leads to the cleavage of downstream substrates and ultimately to the execution of apoptosis.

Regulation of Apoptosis:

The regulation of apoptosis is a complex process that involves a variety of factors, including signaling pathways, post-translational modifications, and protein-protein interactions. In addition to the Bcl-2 family, numerous other proteins have been identified that regulate apoptosis, including the IAP family of proteins, which inhibit caspase activity, and the p53 tumor suppressor, which can promote apoptosis in response to DNA damage.

Apoptosis in Development:

Apoptosis plays a critical role in development, helping to shape tissues and eliminate unwanted cells. During development, apoptosis occurs in a highly regulated manner and is tightly controlled by a variety of signaling pathways and molecular interactions. For example, in the development of the nervous system, apoptosis plays a critical role in eliminating excess neurons and shaping

Mechanisms of Apoptosis:

Apoptosis is a highly regulated process that is triggered by a variety of signals, both internal and external to the cell. These signals can activate a number of different intracellular pathways that ultimately converge on a

common set of molecular events that result in cell death. The key events that occur during apoptosis can be grouped into three main stages: initiation, execution, and clearance.

Initiation:

Apoptosis can be initiated by a variety of signals, including oxidative stress, DNA damage, growth factor deprivation, and cytokine signaling. These signals can activate a number of different intracellular pathways, including the intrinsic and extrinsic pathways.

The intrinsic pathway is initiated by internal signals, such as DNA damage, that lead to the release of pro-apoptotic proteins from the mitochondria. These proteins, including cytochrome c, then activate a cascade of proteases called caspases, which ultimately lead to cell death.

The extrinsic pathway, on the other hand, is initiated by external signals, such as the binding of death ligands to their corresponding death receptors on the cell surface. This binding activates a series of intracellular signaling pathways that ultimately lead to caspase activation and cell death.

Execution:

Once initiated, the apoptotic pathway proceeds through a series of molecular events that ultimately lead to the dismantling of the cell. The key events that occur during the execution phase of apoptosis include caspase activation, DNA fragmentation, cytoskeletal disassembly, and phagocytosis of apoptotic bodies.

Caspases are a family of cysteine proteases that play a central role in the execution of apoptosis. There are two types of caspases: initiator caspases and effector caspases. Initiator caspases, such as caspase-8 and caspase-9, are activated early in the apoptotic process and then go on to activate the effector caspases, such as caspase-3 and caspase-7, which are responsible for the dismantling of the cell.

DNA fragmentation is another key event that occurs during apoptosis. This fragmentation is mediated by endonucleases, which cleave the DNA into fragments of approximately 200 base pairs. These fragments are then

packaged into apoptotic bodies, which are subsequently engulfed and degraded by neighboring cells.

Cytoskeletal disassembly is also a critical event in the execution of apoptosis. This disassembly is mediated by a number of different mechanisms, including the activation of caspases and the disruption of actin filaments and microtubules. The disassembly of the cytoskeleton ultimately leads to the formation of apoptotic bodies.

Clearance:

The final stage of apoptosis is clearance, which involves the phagocytosis and removal of apoptotic bodies by neighboring cells. This clearance process is critical to the maintenance of tissue homeostasis and the prevention of inflammation and tissue damage.

The phagocytosis of apoptotic bodies is mediated by a number of different mechanisms, including recognition of apoptotic cells by phagocytes, binding of apoptotic cells to phagocytes, and engulfment of apoptotic cells by phagocytes. Once engulfed, apoptotic bodies are degraded and their contents recycled or eliminated.

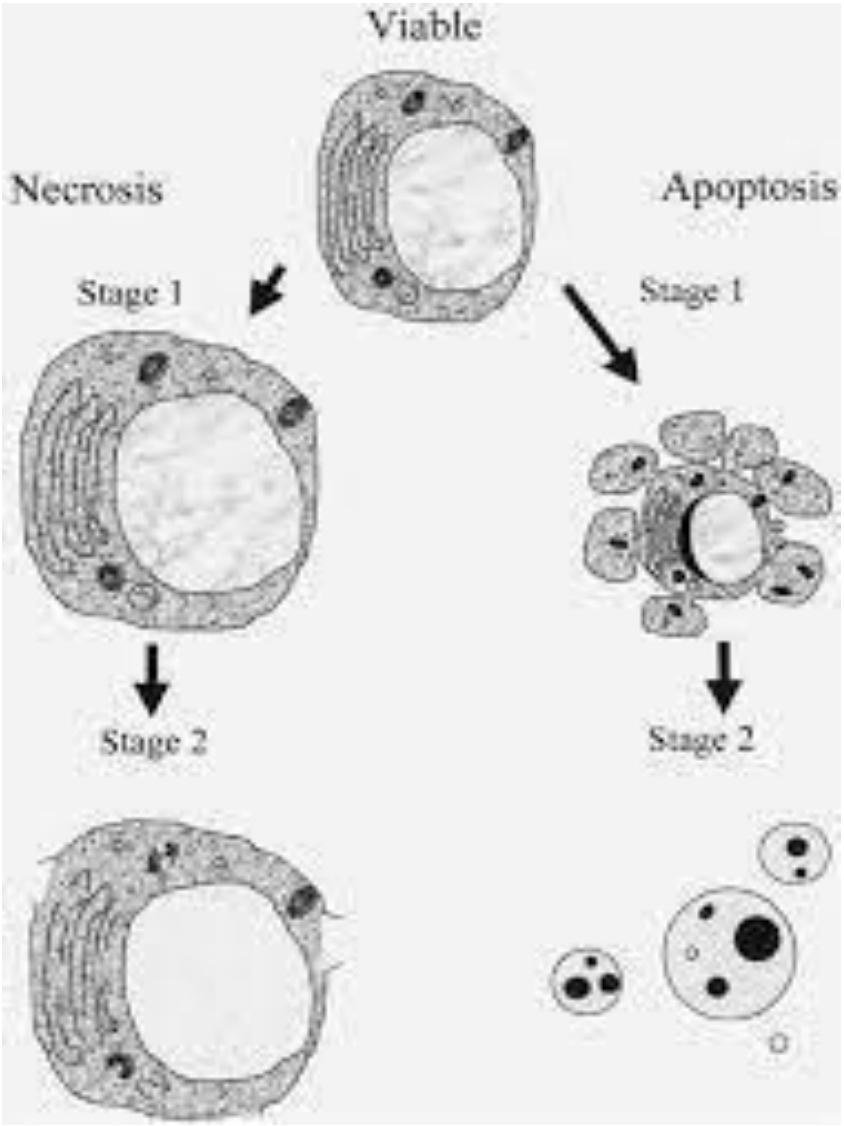

FIGURE:07

4.2 OCCURANCE OF APOPTOSIS

Apoptosis is a common occurrence in multicellular organisms and is a vital process for maintaining proper cellular homeostasis. It plays a critical role in development and tissue turnover, as well as in the removal of damaged or potentially harmful cells. Apoptosis occurs in response to various internal and external signals, including DNA damage, oxidative stress, and the presence of viral or bacterial infections.

During development, apoptosis is essential for sculpting and shaping organs and tissues. It is involved in the separation of fingers and toes, the formation of the neural tube, and the maturation of the immune system. In addition, apoptosis plays a key role in tissue turnover and renewal throughout life,

particularly in rapidly dividing tissues such as the skin and the lining of the digestive tract.

In healthy cells, apoptosis is tightly regulated to prevent unnecessary cell death. The process is initiated by a variety of signals, including growth factor withdrawal, DNA damage, and activation of pro-apoptotic proteins. These signals activate a cascade of intracellular events that ultimately lead to the activation of a family of cysteine proteases called caspases, which carry out the actual destruction of the cell.

However, apoptosis can also occur in response to a variety of pathological conditions, including cancer, neurodegenerative diseases, and autoimmune disorders. In these cases, apoptosis can either be excessive or insufficient, leading to either too much or too little cell death.

In cancer, for example, mutations in genes involved in the regulation of apoptosis can lead to the accumulation of cells that should have been eliminated. This can result in the formation of tumors, as well as resistance to chemotherapy and radiation therapy, which often work by inducing apoptosis in cancer cells.

In neurodegenerative diseases such as Alzheimer's and Parkinson's, the death of specific neurons is a hallmark of the disease. In these cases, apoptosis may be triggered by abnormal protein aggregates, oxidative stress, or other pathological processes. Similarly, in autoimmune diseases, such as lupus and rheumatoid arthritis, apoptosis may be triggered by the presence of autoantibodies that recognize and bind to self-antigens on the surface of cells, leading to their destruction.The occurrence of apoptosis is tightly regulated and plays a crucial role in maintaining cellular homeostasis in healthy individuals. However, when dysregulated, it can contribute to the pathogenesis of a variety of diseases, highlighting the importance of understanding the mechanisms that control apoptosis in health and disease.

4.3 DIAGNOSIS AND STAGES

Cancer is a group of diseases that involve abnormal growth of cells, which can invade and spread to other parts of the body. It is a major public health concern, affecting millions of people worldwide, and is one of the leading causes of death.

Diagnosing cancer involves a combination of medical history, physical examination, imaging tests, and laboratory tests. The goal is to identify cancer at an early stage when it is more likely to be treatable.

Medical History and Physical Examination

The first step in diagnosing cancer is taking a thorough medical history and conducting a physical examination. The doctor will ask about symptoms, risk factors, and family history of cancer. They will also perform a physical exam to look for any signs of cancer, such as lumps, abnormal moles, or enlarged lymph nodes.

Imaging Tests

Imaging tests are used to produce pictures of the inside of the body to help identify cancerous tumors. Common imaging tests include:

X-rays – (This test uses electromagnetic radiation to produce images of bones and some organs)

X-ray (short for X-radiation) refers to a form of electromagnetic radiation that has higher energy and shorter wavelength than visible light. X-rays have the ability to pass through various materials, including body tissues, and produce an image on a photographic film or digital detector. This property makes X-rays valuable in medical imaging, where they are commonly used to visualize the internal structures of the body.

In medical applications, X-rays are used for diagnostic purposes to identify and diagnose various conditions. For example, they can be used to detect bone fractures, tumors, infections, and lung diseases. During an X-ray procedure, a patient is positioned between an X-ray machine and a specialized film or detector. The X-ray machine emits a controlled dose of radiation that passes through the body. The X-rays that are not absorbed by the body's tissues strike the film or detector, producing an image that can be examined by a radiologist.

X-rays are also used in other fields besides medicine. For instance, they are employed in airport security systems to scan luggage and detect any prohibited items. X-ray technology is also utilized in industrial applications, such as inspecting the quality of welds or examining the internal components of

manufactured products.It's worth noting that X-rays are a type of ionizing radiation, meaning they can potentially damage living tissues and cells if exposed to high doses or over prolonged periods. Therefore, appropriate precautions are taken to ensure the safety of both patients and medical personnel during X-ray procedures. Lead aprons and other protective measures are used to minimize radiation exposure. The benefits of X-ray imaging typically outweigh the risks when used judiciously and with proper safety measures

CT scans – (This test uses a combination of X-rays and computer technology to create detailed images of the body)

A CT scan, also known as a computed tomography scan or CAT scan, is a medical imaging procedure that uses a combination of X-rays and computer technology to create detailed cross-sectional images of the body. CT scans provide more detailed information than traditional X-rays and can visualize internal structures, organs, and tissues from different angles.

During a CT scan, the patient lies on a table that moves into a doughnut-shaped machine called a CT scanner. The scanner consists of an X-ray tube that rotates around the patient, emitting a series of X-ray beams. Detectors on the opposite side of the scanner measure the amount of radiation that passes through the body from different angles.The collected data is processed by a computer, which generates cross-sectional images or "slices" of the body. These images can be further reconstructed into 3D representations for a more comprehensive view. CT scans can provide detailed information about bones, organs, blood vessels, and soft tissues, making them valuable in diagnosing a wide range of medical conditions.

CT scans are commonly used to:

1. Detect and diagnose various conditions, such as tumors, infections, and injuries.
2. Assess the extent of trauma or internal injuries after accidents.
3. Guide medical procedures, such as biopsies or needle aspirations.
4. Monitor the effectiveness of ongoing treatments, such as cancer therapy.

Plan radiation therapy and surgical procedures.

CT scans involve exposure to ionizing radiation, similar to X-rays. However, modern CT scanners are designed to minimize radiation exposure while obtaining high-quality images. Radiology technologists and radiologists take precautions to

ensure that the benefits of the scan outweigh the potential risks associated with radiation exposure.

It's important to note that CT scans require a medical prescription and should be performed under the guidance of a healthcare professional. The specific procedure and preparation instructions may vary depending on the area of the body being scanned and the purpose of the examination.

MRI – (This test uses a magnetic field and radio waves to create detailed images of the body).

An MRI scan, or magnetic resonance imaging scan, is a non-invasive medical imaging technique that uses a combination of strong magnetic fields and radio waves to create detailed images of the internal structures of the body. MRI provides highly detailed images of soft tissues, organs, muscles, and other structures, allowing healthcare professionals to diagnose and monitor various medical conditions.

During an MRI scan, the patient lies on a movable table that is inserted into a large, cylindrical machine called an MRI scanner. The scanner contains a powerful magnet that produces a magnetic field around the patient's body. Radio waves are then emitted and received by the scanner, causing the body's atoms to emit signals. These signals are detected by the scanner and processed by a computer to create detailed, cross-sectional images of the body.

MRI scans offer several advantages:

1. Superior soft tissue visualization: MRI provides exceptional detail of soft tissues, making it useful for identifying abnormalities in organs, muscles, ligaments, tendons, and the central nervous system.
2. Multi-planar imaging: MRI can produce images in various planes (sagittal, coronal, and axial), allowing for a comprehensive evaluation of anatomical structures from different angles.
3. Non-invasive and radiation-free: Unlike X-rays and CT scans, MRI does not use ionizing radiation, making it a safe imaging option for most patients, including pregnant women and children.
4. Contrast-enhanced imaging: In some cases, a contrast agent may be administered intravenously to enhance the visibility of certain tissues or blood vessels, aiding in the diagnosis of specific conditions.
5. Functional imaging: Advanced MRI techniques, such as functional MRI (fMRI), can assess brain activity and help map neural connections, making

them valuable in studying brain function and diagnosing neurological disorders.

MRI scans are commonly used to diagnose and monitor various medical conditions, including but not limited to:

1. Brain and spinal cord disorders (e.g., tumors, multiple sclerosis)
2. Musculoskeletal injuries (e.g., torn ligaments, herniated discs)
3. Joint abnormalities (e.g., osteoarthritis, cartilage damage)
4. Abdominal and pelvic conditions (e.g., liver disease, pelvic tumors)
5. Cardiovascular diseases (e.g., heart abnormalities, blood vessel blockages)

Breast and prostate cancer detection and staging

It's important to note that some individuals may not be suitable candidates for an MRI scan due to certain conditions or devices in their body (e.g., pacemakers, cochlear implants, metallic implants). Additionally, MRI scans require cooperation from the patient, as they involve lying still for an extended period inside a confined space, which can be challenging for individuals with claustrophobia. Open MRI scanners or sedation options may be available in such cases.MRI scans are typically ordered by a healthcare professional and should be performed under their guidance. Preparation instructions may vary depending on the specific type of MRI scan being conducted and the area of the body being examined.

PET scans –(This test uses a small amount of radioactive material to produce images of the body and detect areas of abnormal activity, such as cancer cells).

A PET scan, or positron emission tomography scan, is a medical imaging technique that provides information about the metabolic activity of tissues and organs in the body. Unlike other imaging modalities such as X-rays or MRI, which primarily show anatomical structures, PET scans focus on the function of tissues at a molecular level.

During a PET scan, a small amount of a radioactive substance known as a radiotracer is injected into the patient's bloodstream. The radiotracer is typically a compound that is similar to glucose (sugar) but tagged with a radioactive atom. Once inside the body, the radiotracer is absorbed by organs and tissues and undergoes radioactive decay. As it decays, it emits positrons (positively charged particles), which collide with electrons in the body, resulting in the emission of gamma rays.

Detectors surrounding the patient's body detect the gamma rays and relay the information to a computer, which creates detailed 3D images of the metabolic activity within the body. The images generated by a PET scan can show areas of high metabolic activity (where the radiotracer has accumulated) and areas of low activity.

PET scans have several applications in medicine, including:

1. Cancer detection and staging: PET scans can detect abnormal metabolic activity, helping identify cancerous cells, determine the extent of cancer spread, and assess treatment response.
2. Brain disorders: PET scans are used to evaluate brain function, detect abnormalities in conditions such as Alzheimer's disease, epilepsy, and other neurological disorders.
3. Heart disease: PET scans can assess blood flow to the heart, evaluate heart function, and identify areas of damaged heart tissue.
4. Evaluation of other diseases: PET scans can be used to assess various conditions such as infections, inflammation, and certain types of cardiac and neurological diseases.

PET scans are often combined with CT scans to provide both functional and anatomical information. This combined imaging technique is called PET/CT, where the PET scan highlights areas of abnormal metabolic activity, while the CT scan provides precise anatomical localization.It's important to note that PET scans involve the use of radiation due to the radioactive tracer. However, the amount of radiation exposure is generally considered safe and well within acceptable limits. The radiotracer used in PET scans typically has a short half-life, meaning it decays quickly and is eliminated from the body relatively fast.

PET scans require a medical prescription and should be performed under the guidance of a healthcare professional. The specific preparation instructions may vary depending on the purpose of the scan and the area of the body being examined.

Laboratory Tests

Laboratory oncological tests refer to a range of diagnostic tests and procedures performed in a laboratory setting to aid in the diagnosis, prognosis, and monitoring of cancer. These tests are typically ordered by oncologists or other healthcare professionals specializing in the treatment of cancer.

Here are some commonly performed laboratory tests in oncology:

Tumor Markers:

Tumor markers are substances produced by cancer cells or normal cells in response to cancer. They can be detected in blood, urine, or tissue samples. Examples of tumor markers include prostate-specific antigen (PSA) for prostate cancer, carcinoembryonic antigen (CEA) for colorectal and other cancers, and CA-125 for ovarian cancer. Tumor markers are used to screen for certain cancers, assess treatment response, and monitor disease progression.

Genetic Testing:

Genetic testing analyzes DNA or RNA to identify specific genetic mutations or alterations that are associated with an increased risk of developing cancer or affecting treatment options. These tests can include tests for hereditary cancer syndromes (e.g., BRCA1 and BRCA2 mutations) or genomic profiling of tumors to guide targeted therapy selection.

Histopathology:

Histopathology involves the microscopic examination of tissue samples obtained through biopsy or surgery. Pathologists study the tissue samples to determine the presence of cancer cells, their type, grade, and other characteristics. This information is crucial for cancer diagnosis, staging, and treatment planning.

Cytogenetics:

Cytogenetic tests analyze the chromosomes within cells to detect chromosomal abnormalities, such as translocations, deletions, or amplifications. These abnormalities can provide important diagnostic and prognostic information in various types of cancer, including leukemias and lymphomas.

Flow Cytometry:

Flow cytometry is a technique that analyzes the characteristics of individual cells in a sample, such as their size, shape, and protein expression. In oncology, flow cytometry is commonly used to diagnose and classify blood cancers, including leukemia and lymphoma, based on the specific markers expressed on the surface of cells.

Molecular Profiling:

Molecular profiling assesses specific molecular alterations within cancer cells, such as mutations, gene fusions, or changes in gene expression. This information can help guide treatment decisions, including the use of targeted therapies or immunotherapies.

These are just a few examples of laboratory tests used in oncology. The specific tests ordered for an individual patient will depend on factors such as the type of cancer suspected or diagnosed, the stage of the disease, and the goals of the testing as determined by the healthcare provider. The results of these tests are important in developing an accurate diagnosis and tailoring an appropriate treatment plan for each patient.

Biopsy – (**This involves taking a sample of tissue from a suspected tumor to be examined under a microscope for signs of cancer.)**

A biopsy is a medical procedure performed in oncology to obtain a tissue sample from a suspicious area or tumor for further examination and diagnosis. It involves the removal of a small amount of tissue, cells, or fluid from the body, which is then examined under a microscope by a pathologist to determine if cancer or other abnormalities are present.

There are different types of biopsies used in oncology, depending on the location and nature of the suspected cancer:

Needle Biopsy:

This type of biopsy involves inserting a thin needle into the tumor or affected area to obtain a tissue sample. There are different types of needle biopsies, including:

Fine-needle aspiration (FNA):

Uses a thin needle to extract cells or fluid from a lump or suspicious area.

Core needle biopsy:

Uses a slightly larger needle to remove a small cylinder of tissue from the tumor.

Vacuum-assisted biopsy:

Utilizes a needle with a vacuum-powered device to collect multiple tissue samples with a single insertion.

Surgical Biopsy:

In some cases, a surgical biopsy may be necessary to obtain a larger tissue sample or if the tumor is deep within the body. Surgical biopsies can be open biopsies, where a surgeon makes an incision to access the tumor, or minimally invasive procedures, such as laparoscopic or endoscopic biopsies, which use small incisions and specialized tools to remove tissue samples.

Excisional Biopsy:

In certain cases, when a small tumor is suspected, the entire tumor may be removed during the biopsy procedure. This is known as an excisional biopsy and can serve both diagnostic and therapeutic purposes.

The collected tissue samples are sent to a pathology laboratory, where a pathologist examines them under a microscope. The pathologist looks for signs of cancer cells, their characteristics, and other features that help determine the type, grade, and stage of the cancer. This information is crucial in guiding treatment decisions and developing an appropriate treatment plan.Biopsies are typically performed under local anesthesia, but in some cases, general anesthesia may be used. The specific procedure and recovery process depend on the type and location of the biopsy performed.

It's important to note that biopsies are not always necessary for all suspected cancer cases, especially if the diagnosis can be made through non-invasive imaging techniques or if the tumor is easily accessible for complete surgical removal. The decision to perform a biopsy is made based on individual patient factors and the judgment of the healthcare team involved in the patient's care.

Blood tests - These tests can detect certain substances in the blood that may be associated with cancer, such as tumor markers.

Urine tests - These tests can detect certain substances in the urine that may be associated with cancer.

Genetic tests - These tests can detect mutations in genes that are associated with an increased risk of developing certain types of cancer.

STAGING

Once a diagnosis of cancer has been made, the next step is to determine the stage of the cancer. Staging refers to the extent of the cancer and how far it has spread. The stage of cancer is important in determining the best treatment options and the prognosis (outlook) for the patient.

The stage of cancer is determined by a combination of imaging tests and other diagnostic tests, such as biopsies. The stages of cancer are generally classified as follows:

Stage 0 - Cancer is in its earliest stage and has not spread beyond the site where it started.

Stage 0 cancer, also known as carcinoma in situ, refers to a very early stage of cancer where abnormal cells are present only in the layer of cells where they first formed and have not spread to nearby tissues or other parts of the body.

Stage 0 cancer is typically detected through screening tests, such as mammograms for breast cancer or colonoscopies for colon cancer, before any symptoms are present. Treatment for stage 0 cancer may involve surgery to remove the abnormal cells or close monitoring to watch for any changes in the cells.

The prognosis for stage 0 cancer is generally very good, as the cancer is localized and has not spread to other parts of the body. However, if left untreated, stage 0 cancer can progress to more advanced stages of cancer, which may be more difficult to treat.

It is important to follow recommended screening guidelines and to discuss any concerns about cancer with a healthcare professional. Early detection and treatment can greatly increase the chances of a successful outcome and improve overall quality of life.

Stage I - Cancer is localized and has not spread to nearby lymph nodes or other parts of the body.

Stage I cancer is an early stage of cancer that has not yet spread to nearby tissues or lymph nodes. It is typically smaller in size than later stages of cancer and has a good prognosis when detected early.

Types of Stage I Cancer

Stage I cancer can occur in various parts of the body, including the breast, lung, colon, skin, prostate, and others. Each type of cancer has its own set of symptoms, diagnostic tests, and treatment options.

Breast Cancer: In stage I breast cancer, the cancer is typically small and has not spread to nearby lymph nodes. Symptoms may include a lump in the breast, changes in the shape or size of the breast, or changes in the skin over the breast.

Lung Cancer: Stage I lung cancer refers to cancer that is confined to the lung and has not spread to other parts of the body. Symptoms may include coughing, shortness of breath, chest pain, or coughing up blood.

Colon Cancer: In stage I colon cancer, the cancer has not yet spread beyond the inner lining of the colon. Symptoms may include changes in bowel habits, blood in the stool, abdominal pain, or unexplained weight loss.

Skin Cancer: Stage I skin cancer refers to cancer that is confined to the top layer of the skin and has not spread to nearby lymph nodes or other parts of the body. Symptoms may include a change in the appearance of a mole or other skin lesion, or a new growth on the skin.

Prostate Cancer: Stage I prostate cancer refers to cancer that is small and has not spread outside of the prostate gland. Symptoms may include difficulty urinating, blood in the urine or semen, or erectile dysfunction.

Diagnosis of Stage I Cancer

Diagnosis of stage I cancer typically involves a combination of imaging tests, laboratory tests, and biopsies. The goal is to determine the type and stage of cancer and to develop a treatment plan tailored to the patient's individual needs.

Imaging Tests: Imaging tests may include X-rays, CT scans, MRI scans, PET scans, or ultrasound tests. These tests can help identify the location and size of the cancer and whether it has spread to nearby tissues or lymph nodes.

Laboratory Tests: Laboratory tests may include blood tests, urine tests, or other tests to detect specific substances in the body that may be associated with cancer.

Biopsy: A biopsy involves taking a small sample of tissue from the area suspected of being cancerous and examining it under a microscope. This can help confirm the diagnosis of cancer and provide information on the type and stage of the cancer.

Staging of Stage I Cancer

Staging of cancer refers to the extent of the cancer and how far it has spread. In stage I cancer, the cancer is typically localized to a specific area and has not spread to nearby tissues or lymph nodes.

Stage II - Cancer has grown larger and may have spread to nearby lymph nodes, but has not spread to other parts of the body.

Stage II cancer is an early stage of cancer that has grown beyond the initial site and may have spread to nearby tissues or lymph nodes. It is typically larger in size than stage I cancer and may have a slightly lower prognosis, but early detection and treatment can still lead to successful outcomes.

Types of Stage II Cancer

Stage II cancer can occur in various parts of the body, including the breast, lung, colon, skin, prostate, and others. Each type of cancer has its own set of symptoms, diagnostic tests, and treatment options.

Breast Cancer: In stage II breast cancer, the cancer has grown beyond the initial site and may have spread to nearby lymph nodes. Symptoms may include a lump in the breast, changes in the shape or size of the breast, or changes in the skin over the breast.

Lung Cancer: Stage II lung cancer refers to cancer that has grown beyond the lung and may have spread to nearby lymph nodes. Symptoms may include coughing, shortness of breath, chest pain, or coughing up blood.

Colon Cancer: In stage II colon cancer, the cancer has grown beyond the inner lining of the colon and may have spread to nearby lymph nodes. Symptoms may include changes in bowel habits, blood in the stool, abdominal pain, or unexplained weight loss.

Skin Cancer: Stage II skin cancer refers to cancer that has grown beyond the top layer of the skin and may have spread to nearby lymph nodes or other parts of the body. Symptoms may include a change in the appearance of a mole or other skin lesion, or a new growth on the skin.

Prostate Cancer: Stage II prostate cancer refers to cancer that has grown beyond the prostate gland and may have spread to nearby tissues or lymph nodes.

Symptoms may include difficulty urinating, blood in the urine or semen, or erectile dysfunction.

Diagnosis of Stage II Cancer

Diagnosis of stage II cancer typically involves a combination of imaging tests, laboratory tests, and biopsies. The goal is to determine the type and stage of cancer and to develop a treatment plan tailored to the patient's individual needs.

Imaging Tests: Imaging tests may include X-rays, CT scans, MRI scans, PET scans, or ultrasound tests. These tests can help identify the location and size of the cancer and whether it has spread to nearby tissues or lymph nodes.

Laboratory Tests: Laboratory tests may include blood tests, urine tests, or other tests to detect specific substances in the body that may be associated with cancer.

Biopsy: A biopsy involves taking a small sample of tissue from the area suspected of being cancerous and examining it under a microscope. This can help confirm the diagnosis of cancer and provide information on the type and stage of the cancer.

Staging of Stage II Cancer

Staging of cancer refers to the extent of the cancer and how far it has spread. In stage II cancer, the cancer has typically grown beyond the initial site and may have spread to nearby tissues or lymph nodes.

Stage III - Cancer has spread to nearby lymph nodes and may have grown into nearby tissues, but has not spread to other parts of the body.

Stage III cancer is an advanced stage of cancer that has spread beyond the initial site to nearby lymph nodes or other tissues. It is typically larger and more invasive than stage II cancer, and the prognosis may be less favorable. However, with proper treatment, many people with stage III cancer can still achieve remission or long-term survival.

Types of Stage III Cancer

Stage III cancer can occur in various parts of the body, including the breast, lung, colon, skin, prostate, and others. Each type of cancer has its own set of symptoms, diagnostic tests, and treatment options.

Breast Cancer: In stage III breast cancer, the cancer has spread to nearby lymph nodes or other tissues in the breast. Symptoms may include a lump in the breast, changes in the shape or size of the breast, or changes in the skin over the breast.

Lung Cancer: Stage III lung cancer refers to cancer that has spread beyond the lung and may have affected nearby lymph nodes or other tissues. Symptoms may include coughing, shortness of breath, chest pain, or coughing up blood.

Colon Cancer: In stage III colon cancer, the cancer has grown through the outer layers of the colon and may have spread to nearby lymph nodes or other tissues. Symptoms may include changes in bowel habits, blood in the stool, abdominal pain, or unexplained weight loss.

Skin Cancer: Stage III skin cancer refers to cancer that has spread to nearby lymph nodes or other tissues, or has grown beyond the top layer of the skin. Symptoms may include a change in the appearance of a mole or other skin lesion, or a new growth on the skin.

Prostate Cancer: Stage III prostate cancer refers to cancer that has spread beyond the prostate gland and may have affected nearby tissues or lymph nodes. Symptoms may include difficulty urinating, blood in the urine or semen, or erectile dysfunction.

Diagnosis of Stage III Cancer

Diagnosis of stage III cancer typically involves a combination of imaging tests, laboratory tests, and biopsies. The goal is to determine the type and stage of cancer and to develop a treatment plan tailored to the patient's individual needs.

Imaging Tests: Imaging tests may include X-rays, CT scans, MRI scans, PET scans, or ultrasound tests. These tests can help identify the location and size of the cancer and whether it has spread to nearby tissues or lymph nodes.

Laboratory Tests: Laboratory tests may include blood tests, urine tests, or other tests to detect specific substances in the body that may be associated with cancer.

Biopsy: A biopsy involves taking a small sample of tissue from the area suspected of being cancerous and examining it under a microscope. This can help confirm the diagnosis of cancer and provide information on the type and stage of the cancer.

Staging of Stage III Cancer

Staging of cancer refers to the extent of the cancer and how far it has spread. In stage III cancer, the cancer has typically spread beyond the initial site to nearby lymph nodes or other tissues.

The stage of stage III cancer is further subdivided into three subcategories:

Stage IIIA: The cancer has spread to nearby lymph nodes, but they are not large or have not grown into nearby tissues.

Stage IIIB: The cancer has spread to nearby lymph nodes that are larger or have grown into nearby tissues.

Stage IIIC: The cancer has spread to nearby lymph nodes, as well as other nearby tissues or organs.

Stage IV - Cancer has spread to other parts of the body, such as the lungs, liver, or bones.

Stage IV cancer, also known as metastatic cancer, is an advanced stage of cancer that has spread from the original site to other parts of the body. This type of cancer is typically considered incurable, but treatment can help manage symptoms, prolong survival, and improve quality of life.

Types of Stage IV Cancer

Stage IV cancer can occur in various parts of the body, including the breast, lung, colon, skin, prostate, and others. Each type of cancer has its own set of symptoms, diagnostic tests, and treatment options.

Breast Cancer: In stage IV breast cancer, the cancer has spread beyond the breast to other parts of the body, such as the bones, liver, lungs, or brain. Symptoms may include bone pain, shortness of breath, fatigue, or confusion.

Lung Cancer: Stage IV lung cancer refers to cancer that has spread to distant sites in the body, such as the brain, bones, or liver. Symptoms may include coughing, shortness of breath, chest pain, or coughing up blood.

Colon Cancer: In stage IV colon cancer, the cancer has spread to other parts of the body, such as the liver, lungs, or bones. Symptoms may include changes in bowel habits, blood in the stool, abdominal pain, or unexplained weight loss.

Skin Cancer: Stage IV skin cancer refers to cancer that has spread to distant sites in the body, such as the lymph nodes, liver, lungs, or brain. Symptoms may include a change in the appearance of a mole or other skin lesion, or a new growth on the skin.

Prostate Cancer: Stage IV prostate cancer refers to cancer that has spread to other parts of the body, such as the bones, liver, or lungs. Symptoms may include difficulty urinating, bone pain, or unexplained weight loss.

Diagnosis of Stage IV Cancer

Diagnosis of stage IV cancer typically involves a combination of imaging tests, laboratory tests, and biopsies. The goal is to determine the type and stage of cancer and to develop a treatment plan tailored to the patient's individual needs.

Imaging Tests: Imaging tests may include X-rays, CT scans, MRI scans, PET scans, or ultrasound tests. These tests can help identify the location and size of the cancer and whether it has spread to other parts of the body.

Laboratory Tests: Laboratory tests may include blood tests, urine tests, or other tests to detect specific substances in the body that may be associated with cancer.

Biopsy: A biopsy involves taking a small sample of tissue from the area suspected of being cancerous and examining it under a microscope. This can help confirm the diagnosis of cancer and provide information on the type and stage of the cancer.

Staging of Stage IV Cancer

Staging of cancer refers to the extent of the cancer and how far it has spread. In stage IV cancer, the cancer has spread beyond the initial site to other parts of the body.

The stage of stage IV cancer is further subdivided into three subcategories:

Stage IVA: The cancer has spread to one distant site in the body, such as the liver, lungs, or bones.

Stage IVB: The cancer has spread to more than one distant site in the body, such as the liver, lungs, bones, or brain.

Stage IVC: The cancer has spread throughout the body, including to distant sites in organs such as the liver, lungs, bones, or brain.

CHAPTER 5

TREATMENT

Treatment for conditions related to apoptosis depends on the specific disease or disorder involved. For example, cancer treatment may involve chemotherapy or radiation therapy to induce apoptosis in cancer cells, while treatment for neurodegenerative diseases may focus on preventing excessive apoptosis in affected neurons. Overall, treatment approaches aim to restore proper apoptotic regulation and promote overall cellular health.

THERE ARE MAINLY FOUR TYPES OF TREATMENTS ARE AVAILABLE FOR CANCER

THEY ARE ,

- PRECISION MEDICINE
- SURGERY
- CHEMOTHERAPY
- IMMUNOTHERAPY

5.1 PRECISION MEDICINE

Precision medicine is a rapidly growing field that aims to tailor medical treatments to the unique characteristics of individual patients. In the context of cancer, precision medicine involves using genomic and other molecular information to identify specific molecular targets that can be targeted with drugs or other therapies. This approach holds great promise for improving cancer treatment outcomes and reducing the burden of cancer worldwide.

The development of precision medicine approaches for cancer is made possible by advances in genomic sequencing technologies, which have allowed researchers to identify a wide range of genetic mutations and other molecular alterations that are associated with cancer development and progression. By analyzing the DNA of cancer cells, researchers can identify specific mutations or other genetic alterations that may be driving the growth and spread of a patient's tumor.

One of the most well-known examples of precision medicine in cancer treatment is the use of targeted therapies. Targeted therapies are drugs that are designed to inhibit specific molecular targets that are involved in cancer cell growth and survival. For example, some targeted therapies work by inhibiting the activity of specific proteins or enzymes that are overactive in cancer cells, while others work by blocking the signaling pathways that promote cancer cell growth and survival.

Targeted therapies have shown great promise in the treatment of several types of cancer, particularly those that are driven by specific genetic mutations or other molecular alterations. For example, the drug imatinib, which targets the BCR-ABL protein that is overactive in chronic myelogenous leukemia, has revolutionized the treatment of this disease, leading to improved survival rates and better quality of life for patients.

Another approach to precision medicine in cancer treatment involves the use of immune checkpoint inhibitors. Immune checkpoint inhibitors are drugs that work by blocking proteins that are involved in the suppression of the immune response. By blocking these proteins, immune checkpoint inhibitors can help to unleash the power of the immune system to attack cancer cells.

Like targeted therapies, immune checkpoint inhibitors have shown great promise in the treatment of certain types of cancer, particularly those that are resistant to other forms of treatment. For example, the drug pembrolizumab has been shown to improve survival in patients with advanced melanoma and certain types of lung cancer.In addition to targeted therapies and immune checkpoint inhibitors, precision medicine approaches for cancer treatment also include the use of molecular profiling to guide treatment decisions. Molecular profiling involves analyzing the genetic and molecular characteristics of a patient's tumor to identify specific mutations or other molecular alterations that may be driving the growth and spread of the cancer.This information can then be used to select the most appropriate treatment for the patient, based on the molecular characteristics of their tumor. For example, a patient with a particular mutation may be more likely to respond to a targeted therapy that inhibits the activity of the protein encoded by that mutation.

Molecular profiling is becoming increasingly important in the treatment of cancer, as more and more targeted therapies and other precision medicine approaches are developed. In addition, advances in genomic sequencing technologies are making it possible to sequence a patient's tumor more quickly and accurately than ever before, allowing for more personalized and effective treatment decisions.

Overall, precision medicine holds great promise for improving cancer treatment outcomes and reducing the burden of cancer worldwide. By tailoring treatments to the unique characteristics of individual patients, precision medicine approaches can help to improve survival rates, reduce side effects, and improve quality of life for cancer patients. While there is still much work to be done to fully realize the potential of precision medicine in cancer treatment, the future looks bright for this exciting and rapidly evolving field

5.2 SURGERY

Surgery is one of the most common treatment options for cancer and involves the removal of the cancerous tissue from the body. The main goal of surgery is to completely remove the cancerous tissue and prevent it from spreading to other parts of the body. The success of surgery depends on various factors such as the type and stage of cancer, location of the tumor, the patient’s overall health, and the surgeon’s experience.

Types of Surgery:

Curative Surgery:

Curative surgery is the primary treatment for cancer and involves the complete removal of the cancerous tissue. The goal of curative surgery is to remove the cancerous tissue and prevent it from spreading to other parts of the body. This type of surgery is usually performed in the early stages of cancer when the tumor is still localized.

Palliative Surgery:

Palliative surgery is performed to relieve the symptoms of cancer, such as pain, bleeding, or difficulty breathing, when the cancer has spread to other

parts of the body. This type of surgery does not aim to cure the cancer, but rather to improve the patient's quality of life.

Preventive Surgery:

Preventive surgery is performed in people who have a high risk of developing cancer, such as those with a family history of cancer or those with a genetic predisposition to cancer. This type of surgery aims to remove the tissue that is at risk of developing cancer and reduce the risk of cancer.

Diagnostic Surgery:

Diagnostic surgery is performed to confirm the presence of cancer and obtain a tissue sample for analysis. This type of surgery is usually performed when other diagnostic tests, such as imaging or biopsy, are inconclusive.

Reconstructive Surgery:

Reconstructive surgery is performed after the removal of cancerous tissue to restore the appearance and function of the affected area. This type of surgery is commonly used in breast cancer patients who have undergone a mastectomy.

Risks and Side Effects:

Like any surgical procedure, cancer surgery also carries certain risks and side effects. Some of the common risks associated with cancer surgery include bleeding, infection, reaction to anesthesia, and damage to nearby organs or tissues. Some of the common side effects of cancer surgery include pain, swelling, and bruising at the site of the incision, fatigue, and loss of appetite.

Recovery:

The recovery time after cancer surgery varies depending on the type of surgery and the patient's overall health. In general, patients are advised to avoid strenuous physical activity and heavy lifting for several weeks after surgery. Patients may also be advised to undergo physical therapy to regain strength and mobility in the affected area. The surgeon will provide specific instructions on postoperative care, such as wound care and pain management.

Follow-Up Care:

Follow-up care is an essential component of cancer treatment and involves regular check-ups to monitor the patient's recovery and detect any signs of recurrence. The follow-up care plan may include regular physical exams, imaging tests, and blood tests. The frequency and duration of follow-up care depend on the type and stage of cancer and the patient's overall health.

Conclusion:

Surgery plays a vital role in the treatment of cancer and can be curative, palliative, preventive, diagnostic, or reconstructive. The success of surgery depends on various factors such as the type and stage of cancer, location of the tumor, the patient's overall health, and the surgeon's experience. Like any surgical procedure, cancer surgery also carries certain risks and side effects. Patients should discuss the risks and benefits of surgery with their healthcare provider and carefully follow the postoperative care plan to ensure a successful recovery

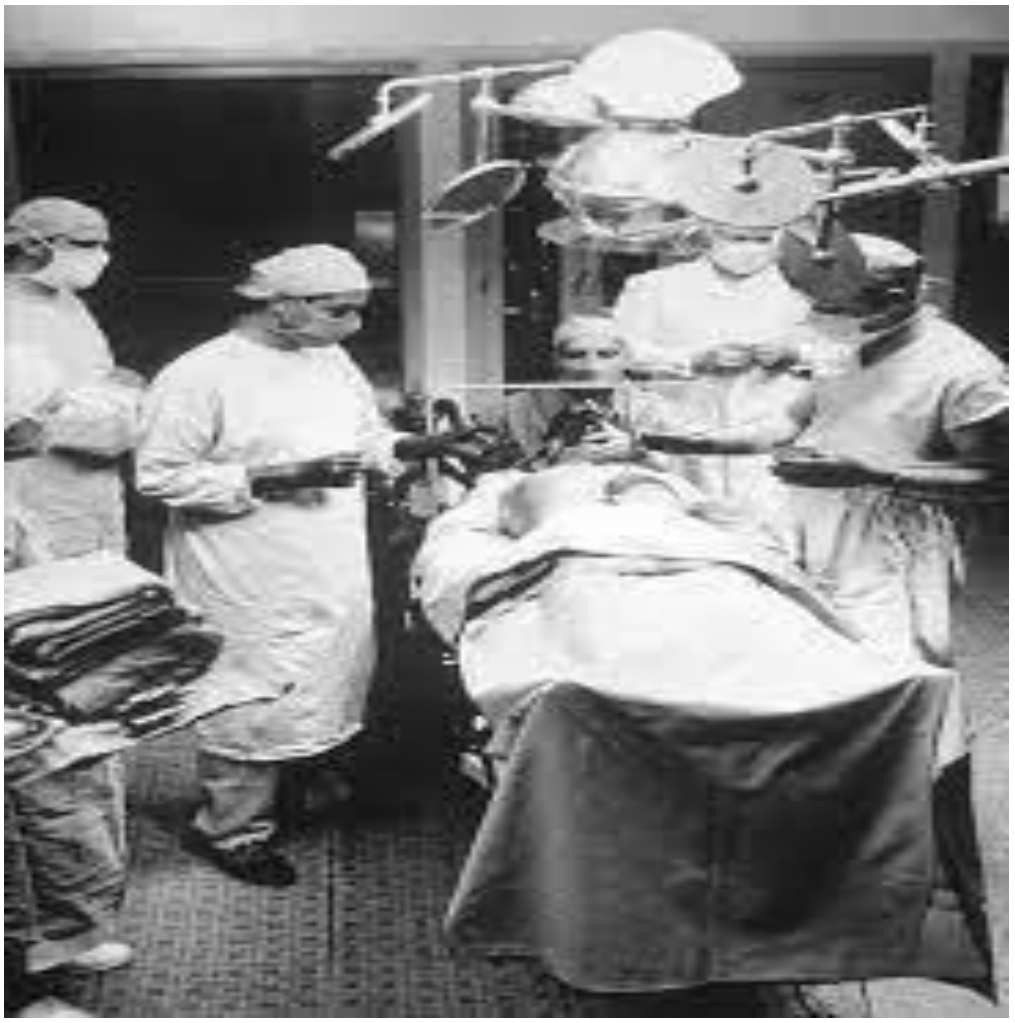

FIGURE:08

5.3 CHEMOTHERAPY

Chemotherapy is a type of cancer treatment that uses powerful drugs to kill cancer cells or slow down their growth. It is one of the most common and widely used treatments for cancer. The drugs used in chemotherapy work by targeting and destroying rapidly dividing cancer cells. However, they can also affect healthy cells that divide rapidly, such as those in the bone marrow, gastrointestinal tract, and hair follicles, leading to side effects.

Chemotherapy can be administered in several ways, including intravenously (through a vein), orally (by mouth), topically (applied to the skin), or intramuscularly (injected into a muscle). The choice of chemotherapy drugs and the method of administration depend on several factors, including the type of cancer, stage of cancer, overall health of the patient, and other treatments received.

Chemotherapy is used for several purposes in the treatment of cancer, including:

Curative treatment:

Chemotherapy can be used as the primary treatment for some types of cancer, such as leukemia, lymphoma, and testicular cancer. In these cases, chemotherapy can often cure the cancer, especially when combined with other treatments such as radiation therapy or surgery.

Adjuvant therapy: Adjuvant chemotherapy is given after surgery to kill any remaining cancer cells and reduce the risk of cancer recurrence. It is commonly used for breast cancer, colorectal cancer, and lung cancer.

Neoadjuvant therapy: Neoadjuvant chemotherapy is given before surgery to shrink the tumor and make it easier to remove. This approach is commonly used for breast cancer, lung cancer, and other types of cancer.

Palliative treatment: Chemotherapy can be used to relieve symptoms of advanced or metastatic cancer, such as pain, bleeding, or breathing difficulties.

While chemotherapy can be effective in killing cancer cells, it can also cause several **side effects**, including:

Nausea and vomiting: Chemotherapy drugs can affect the digestive system, leading to nausea and vomiting. Anti-nausea medication can be given to help manage these side effects.

Hair loss: Chemotherapy drugs can cause hair loss, although the severity and extent of hair loss depend on the type of drug and the dose.

Fatigue: Chemotherapy can cause fatigue, weakness, and a general feeling of malaise.

Increased risk of infection: Chemotherapy can weaken the immune system, increasing the risk of infection.

Anemia: Chemotherapy can lower the number of red blood cells, leading to anemia and fatigue.

Increased risk of bleeding: Chemotherapy can lower the number of platelets, which are responsible for blood clotting, leading to an increased risk of bleeding and bruising.

Neuropathy: Some chemotherapy drugs can damage nerves, leading to numbness, tingling, or weakness in the hands and feet.

Despite these side effects, chemotherapy remains an important and effective treatment for many types of cancer. Several new drugs and drug combinations are currently being developed and tested in clinical trials, with the goal of improving treatment outcomes and reducing side effects.

FIGURE:09

5.4 IMMUNOTHERAPY

Immunotherapy is a type of cancer treatment that aims to harness the body's own immune system to target and destroy cancer cells. The immune system is capable of recognizing and eliminating cancer cells, but in some cases, cancer cells can evade the immune system's detection and destruction. Immunotherapy works by enhancing the immune system's ability to recognize and attack cancer cells, thereby improving the body's natural defense against cancer.

There are several different types of immunotherapy, each with its own mechanism of action. One type of immunotherapy is monoclonal antibodies, which are synthetic proteins designed to recognize and bind to specific proteins on the surface of cancer cells. By binding to these proteins, monoclonal antibodies can either directly destroy cancer cells or trigger an immune response that leads to the destruction of cancer cells.

Another type of immunotherapy is checkpoint inhibitors, which are drugs that target molecules on immune cells that act as "checkpoints" to prevent the immune system from attacking healthy cells. Cancer cells can sometimes use these checkpoints to evade the immune system's detection and destruction. Checkpoint inhibitors work by blocking these checkpoints, thereby allowing the immune system to recognize and attack cancer cells.

Adoptive cell therapy is another type of immunotherapy that involves removing immune cells from a patient, genetically modifying them to recognize and attack cancer cells, and then re-infusing them back into the patient's body. This type of immunotherapy has shown promising results in the treatment of certain types of cancer, such as leukemia and lymphoma.

Cancer vaccines are another type of immunotherapy that work by stimulating the immune system to recognize and attack cancer cells. Unlike traditional vaccines, which are designed to prevent infectious diseases, cancer vaccines are designed to treat existing cancer by stimulating an immune response against cancer cells.One of the major advantages of immunotherapy is its potential for long-term remission and even cure. Unlike chemotherapy and radiation therapy, which often have significant side effects and can damage healthy cells along with cancer cells, immunotherapy targets cancer cells specifically, sparing healthy cells from damage. Additionally, immunotherapy can be effective in treating cancers that are resistant to traditional chemotherapy and radiation therapy.

However, immunotherapy is not without its limitations and potential side effects. Some patients may not respond to immunotherapy, and in some cases, the immune system may attack healthy cells along with cancer cells, leading to autoimmune reactions. Additionally, immunotherapy can be expensive and may require a significant amount of time and resources., immunotherapy represents a promising avenue for the treatment of cancer, and ongoing research is exploring new ways to harness the power of the immune system to fight cancer. As our understanding of the immune system and cancer biology continues to advance, it is likely that immunotherapy will play an increasingly important role in the treatment of cancer

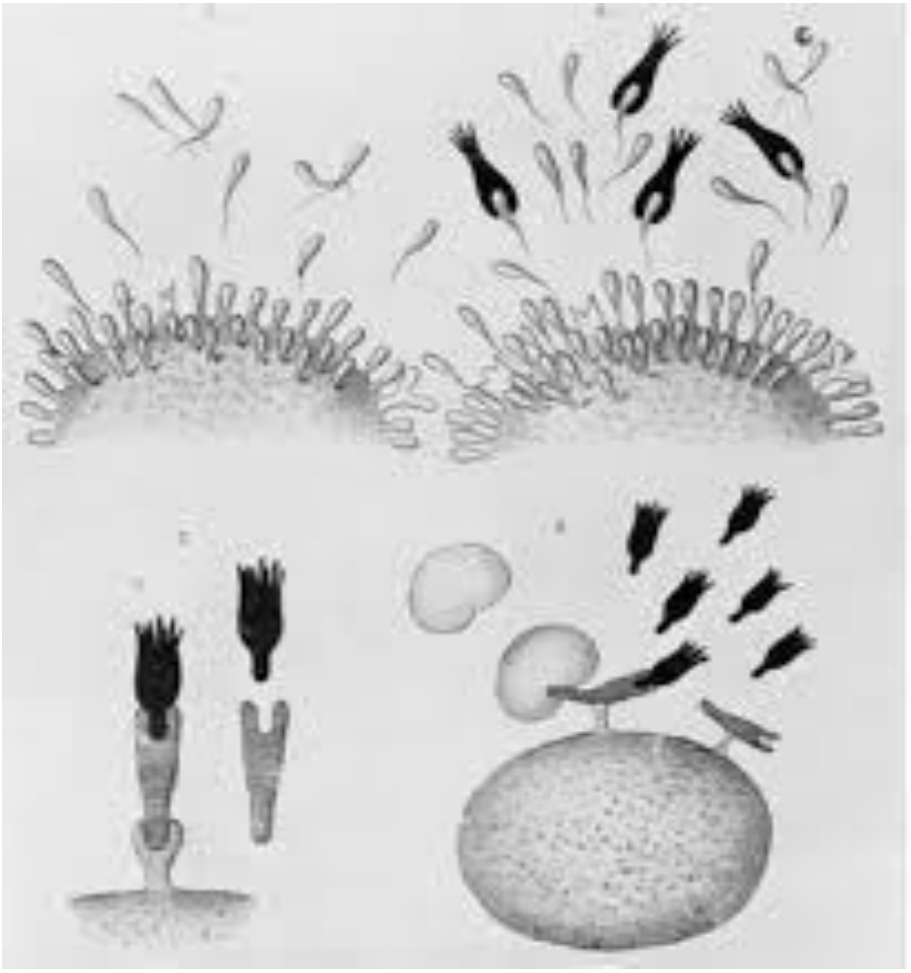

FIGURE:10

BIBLOGRAPHY

1. Pan, Y., Wang, R., Liu, S., Zhan, X., & Wu, Q. (2021). Oncogenic fusion protein EML4-ALK regulates DNA damage response and repair in non-small-cell lung cancer. Cell Death & Disease, 12(2), 1-17.
2. Beatty, G. L., & Gladney, W. L. (2015). Immune escape mechanisms as a guide for cancer immunotherapy. Clinical Cancer Research, 21(4), 687-692.
3. De Sousa, E. M. F., Vermeulen, L., & Richman, S. D. (2017). Medema, JP: targeted therapy resistance mechanisms and therapeutic implications in colorectal cancer. EMBO molecular medicine, 9(7), 935-947.
4. Rahib, L., Smith, B. D., Aizenberg, R., Rosenzweig, A. B., Fleshman, J. M., & Matrisian, L. M. (2014). Projecting cancer incidence and deaths to 2030: the unexpected burden of thyroid, liver, and pancreas cancers in the United States. Cancer research, 74(11), 2913-2921.
5. Liu, Y., Wang, Y., & Lu, X. (2017). Crosstalk between cancer and immune cells: role of tumor-associated macrophages in the tumor microenvironment. Cancer medicine, 6(3), 470-481.
6. Weinberg, R. A. (2013). The biology of cancer. Garland science.
7. Hanahan, D., & Weinberg, R. A. (2011). Hallmarks of cancer: the next generation. cell, 144(5), 646-674.
8. DeVita Jr, V. T., Lawrence, T. S., & Rosenberg, S. A. (2015). DeVita, Hellman, and Rosenberg's cancer: principles & practice of oncology. Lippincott Williams & Wilkins.
9. Vogelstein, B., & Kinzler, K. W. (2004). Cancer genes and the pathways they control. Nature medicine, 10(8), 789-799.
10. Gupta, G. P., & Massagué, J. (2006). Cancer metastasis: building a framework. Cell, 127(4), 679-695.
11. Bickers, B., and Aukim-Hastie, C. (2009). New molecular biomarkers for the prognosis and management of prostate cancer – the post PSA era. Anticancer Research, 29(8): 3289–98. [PubMed]
12. Birch, K. (2017). Rethinking value in the bioeconomy: finance, assetization, and the management of value. Science, Technology, & Human Values, 42(3): 460–90. [PMC free article] [PubMed]
13. Bodkin, H. (2018). Personalised medicine ‘transforms’ survival chances in incurable cancer. The Telegraph, 6 June, www.telegraph.co.uk/science/2018/06/05/personalised-medicine-transforms-survival-chances-incurable/ (accessed 8 July 2019).

14. Borad, M. J., and LoRusso, P. M. (2017). Twenty-first century precision medicine in oncology: genomic profiling in patients with cancer. Mayo Clinic Proceedings, 92(10): 1583–91. [PubMed]
15. Borup, M., Brown, N., Konrad, K., and Van Lente, H. (2006). The sociology of expectations in science and technology. Technology Analysis & Strategic Management, 18(3–4): 285–98.
16. Boseley, S. (2013). New breast cancer test could spare women chemotherapy. The Guardian, 26 September, https://www.theguardian.com/society/2013/sep/25/women-breast-cancer-test-spares-chemotherapy (accessed 20 June 2020).
17. Bourret, P., Keating, P., and Cambrosio, A. (2011). Regulating diagnosis in post-genomic medicine: re-aligning clinical judgement? Social Science & Medicine, 73(6): 816–24. [PubMed]
18. Braun, K., Moore, A., Herrmann, S. L., and Könninger, S. (2010). Science governance and the politics of proper talk: governmental bioethics as a new technology of reflexive government. Economy and Society, 39(4): 510–33.
19. Breast Cancer Now (2018). Breast Cancer Now responds to NICE decision to not to recommend use of tumour profiling tests. https://breastcancernow.org/news-and-blogs/news/nice-decide-not-to-recommend-use-of-tumour-profiling-tests (accessed 5 March 2018).
20. Brown, N., and Michael, M. (2003). A sociology of expectations: retrospecting prospects and prospecting retrospects. Technology Analysis & Strategic Management, 15(1): 3–18.
21. Brown, N., and Rappert, B. (2017). Contested futures: a sociology of prospective techno-science. Abingdon: Routledge.
22. Brown, P., and de Graaf, S. (2013). Considering a future which may not exist: the construction of time and expectations amidst advanced-stage cancer. Health, Risk & Society, 15(6–7): 543–60.
23. Brown, P., de Graaf, S., Hillen, M., Smets, E., and van Laarhoven, H. (2015). The interweaving of pharmaceutical and medical expectations as dynamics of micro-pharmaceuticalisation: advanced-stage cancer patients' hope in medicines alongside trust in professionals. Social Science & Medicine, 131: 313–21. [PubMed]
24. Brown, P., Hashem, F., and Calnan, M. (2016). Trust, regulatory processes and NICE decision-making: appraising cost-effectiveness models through appraising people and systems. Social Studies of Science, 46(1): 87–111. [PubMed]
25. Busfield, J. (2006). Pills, power, people: sociological understandings of the pharmaceutical industry. Sociology, 40(2): 297–314.

26. Callon, M., and Rabeharisoa, V. (2008). The growing engagement of emergent concerned groups in political and economic life: lessons from the French Association of Neuromuscular Disease Patients. Science, Technology and Human Values, 33: 230–61.
27. Cambrosio, A., Campbell, J., Keating, P., and Bourret, P. (2019). Multi-polar scripts: techno-regulatory environments and the rise of precision oncology diagnostic tests. Social Science & Medicine [online only/early view], 21 May 2019, 112317. 10.1016/j.socscimed.2019.05.022. [PubMed] [CrossRef]
28. Cambrosio, A., Keating, P., Vignola-Gagné, E., Besle, S., and Bourret, P. (2018). Extending experimentation: oncology's fading boundary between research and care. New Genetics and Society, 37(3): 207–26.
29. Cancer Research UK (2014). Breast cancer survival statistics [online]. www.cancerresearchuk.org/health-professional/cancer-statistics /statistics-by-cancer-type/breast-cancer/survival (accessed 31 May 2019).
30. Chapple, A., Ziebland, S., and McPherson, A. (2004). Stigma, shame, and blame experienced by patients with lung cancer: qualitative study. British Medical Journal, 328(7454): 1470. [PMC free article] [PubMed]
31. Chattoo, S., and Ahmad, W. I. U. (2003). The meaning of cancer: illness, biography and identity. In D. Kelleher and G. Leavey (eds), Identity and Health, 19–36. Abingdon: Routledge.
32. Clark, A. E., et al. (2003). Biomedicalization: technoscientific transformations of health, illness, and US biomedicine. American Sociological Review, 68(2): 161–94.
33. Cool, A. (2016). Detaching data from the state: biobanking and building big data in Sweden. BioSocieties, 11(3): 277–95.
34. Cooper, M. (2008). Life as surplus: biotechnics and the transformations of capital. Seattle, WA: Washington University Press.
35. Cooper, M., and Waldby, C. (2014). Clinical labor: tissue donors and research subjects in the global bioeconomy. Durham, NC: Duke University Press.
36. Corrigan, O. (2003). Empty ethics: the problem with informed consent. Sociology of Health & Illness, 25(7): 768–92. [PubMed]
37. Dabbs, D. J., Clark, B. Z., Serdy, K., Onisko, A., Brufsky, A. M., Smalley, S., Perkins, S. and Bhargava, R. (2018). Pathologist's health-care value in the triage of Oncotype DX® testing: a value-based pathology study of tumour biology with outcomes. Histopathology, 73(4): 692–700. [PubMed]

38. Davis, C. (2015). Drugs, cancer and end-of-life care: a case study of pharmaceuticalization? Social Science & Medicine, 131: 207–14. [PMC free article] [PubMed]
39. Davis, C., and Abraham, J. (2013). Unhealthy pharmaceutical regulation: innovation, politics and promissory science. Basingstoke: Palgrave Macmillan.
40. Davies, S. C. (2017). Annual Report of the Chief Medical Officer 2016, Generation Genome. London: Department of Health.
41. Davies, M., and Sque, M. (2002). Living on the outside looking in: a theory of living with advanced breast cancer. International Journal of Palliative Nursing, 8(12): 583–90. [PubMed]
42. de Freitas, C., and Martin, G. (2015). Inclusive public participation in health: policy, practice and theoretical contributions to promote the involvement of marginalised groups in healthcare. Social Science and Medicine, 135: 31–9. [PubMed]
43. Degeling, C., Carter, S. M., and Rychetnik, L. (2015). Which public and why deliberate? A scoping review of public deliberation in public health and health policy research. Social Science & Medicine, 131: 114–21. [PubMed]
44. Derks, M. G., and van de Velde, C. J. (2018). Neoadjuvant chemotherapy in breast cancer: more than just downsizing. The Lancet Oncology, 19(1): 2–3. [PubMed]
45. DeVita, V. T., and Chu, E. (2008). A history of cancer chemotherapy. Cancer Research, 68(21): 8643–53. [PubMed]
46. Dheensa, S., Samuel, G., Lucassen, A. M., and Farsides, B. (2018). Towards a national genomics medicine service: the challenges facing clinical-research hybrid practices and the case of the 100,000 genomes project. Journal of Medical Ethics, 44(6): 397–403. [PMC free article] [PubMed]
47. Dixon-Woods, M., Ashcroft, R. E., Jackson, C. J., Tobin, M. D., Kivits, J., Burton, P. R., and Samani, N. J. (2007). Beyond 'misunderstanding': written information and decisions about taking part in a genetic epidemiology study. Social Science & Medicine, 65(11): 2212–22. [PubMed]
48. Dixon-Woods, M., and Tarrant, C. (2009). Why do people cooperate with medical research? Findings from three studies. Social Science & Medicine, 68(12): 2215–22. [PubMed]
49. Dowsett, M., and Dunbier, A. K. (2008). Emerging biomarkers and new understanding of traditional markers in personalized therapy for breast cancer. Clinical Cancer Research, 14(24): 8019–26. [PubMed]

50. Dussauge, I., Claes-Fredrik, H., and Francis, L. (eds) (2015). Value practices in the life sciences and medicine. Oxford: Oxford University Press.
51. Ebeling, M. F. E. (2016). Healthcare and big data: digital spectres and phantom objects. Basingstoke: Palgrave.
52. Ehlers, N., and Krupar, S. (2014). Hope logics: biomedicine, affective conventions of cancer, and the governing of biocitizenry. Configurations, 22(3): 385–413.
53. Ehrenreich, B. (2001). Welcome to Cancerland: a mammogram leads to a cult of pink kitsch. Harper's Magazine, November, 43–53.
54. Felt, U., and Fochler, M. (2010). Machineries for making publics: inscribing and de-scribing publics in public engagement. Minerva, 48(3): 219–38.
55. Fojo, T., Mailankody, S., and Lo, A. (2014). Unintended consequences of expensive cancer therapeutics – the pursuit of marginal indications and a me-too mentality that stifles innovation and creativity. JAMA Otolaryngology: Head & Neck Surgery, 140(12): 1225–36. doi:10.1001/jamaoto.2014.1570. [PubMed] [CrossRef]
56. Fortun, M. (2008). Promising genomics: Iceland and deCODE genetics in a world of speculation. Berkeley, CA: University of California Press.
57. Frank, A. (2003). Survivorship as craft and conviction: reflections on research in progress. Qualitative Health Research, 13(2): 247–55. [PubMed]
58. Fujimura, J. H. (1996). Crafting science: a sociohistory of the quest for the genetics of cancer. Cambridge, MA: Harvard University Press. [PubMed]
59. Gabe, J., Chamberlain, K., Norris, P., Dew, K., Madden, H., and Hodgetts, D. (2012). The debate about the funding of Herceptin: a case study of 'countervailing powers'. Social Science & Medicine, 75(12): 2353–61. [PubMed]
60. Gallagher, J. (2018). Breast cancer: test means fewer women will need chemotherapy [online]. www.bbc.co.uk/news/health-44347381 (accessed 5 March 2019).
61. Gardner, J., Samuel, G., and Williams, C. (2015). Sociology of low expectations: recalibration as innovation work in biomedicine. Science, Technology, & Human Values, 40(6): 998–1021. [PMC free article]

These are the some of the research article of Cancer Biology

GLOSSARY

- **Anemia**
  - below normal levels of erythrocytes (red blood cells) causing a decrease in the oxygen-carrying capacity of the blood.
- **Benign**
  - Not cancerous - not spreading, usually a more mild disease. Non-malignant.
- **Bone-Marrow-Transplant**
  - A procedure in which a section of bone marrow is taken from one person and transplanted into another. It is used to replace bone marrow that has been damaged or diseased. It can be a treatment option in leukemia.

- **Breast-Cancer**
  - Breast cancer is the most common type of cancer in women aged between 35 to 54, incidence has increased such that 1 in 9 women develop breast cancer in the USA. The most common type of breast cancer that found in the cells of the breast ducts, other types include those of the lobes, and inflammatory breast cancer. Between 5 and 10% of breast cancers are known to be hereditary, women with the defective BRCA1 gene are more likely to develop breast or ovarian cancer.
- **Cachexia**
  - The rapid loss of weight along with fatigue, weakness, and loss of appetite. This can be a serious problem for patients with advanced cancer
- **Immunotherapy**
  - Treatment of disease by stimulating the body's own immune system. This is a type of therapy currently being researched as a treatment for cancer.
- **Immune-System**
  - The body system, made up of many organs and cells, that defends the body against infection, disease, and foreign substances. The immune system is often stimulated in specific ways to fight cancer cells.
- **Hypoplasia**
  - incomplete / under development of a part of the body.
- **I-131**
  - Radioactive Iodine. Iodine is readily uptaken by the thyroid gland, therefore I-131 may be used in small doses for monitoring thyroid tissues (thyroid scanning or "I-131 challenge") or in large doses for treating thyroid cancer ("ablative" I-131).

- **Incidence**
  - The number of occurrences of a given disease within a population. Cancer incidence is the number of new cases of cancer diagnosed in one year. Data on the incidence of cancer are kept by regional and national/cancer/registries.

- **Incidence-Rate**
  - Calculated by dividing the number of new cases of a particular cancer during a given period of time by the number of people known to/be/a/risk

- **Informed-Consent**
  - is where patients agree to a treatment or randomisation to a clinical trial having a reasonable understanding of it.
- **Interferon**
  - interferons: are Proteins produced by the body with the specific purpose of regulating cell functions. Interferons are produced in the laboratory in large quantities, and are sometimes used in the treatment of certain cancers.
- **Interleukin-2**
  - A hormone-like substance produced by the body (certain blood cells, specifically) that stimulates the growth of blood cells important to the body's immune system.
- **Intravenous**
  - (IV) means into a vein.
- **Melanoma**
  - Cancer that begins in the melanocytes and spreads to other skin cells. Melanoma appears on the skin and looks like a new or changing mole.

- **Merkel cell cancer**
  - Merkel cell cancer (also known as trabecular cancer, or neuroendocrine cancer of the skin) is a rare type of malignancy developing on or just beneath the skin. These tumours can develop at any age, but the peak incidence is between ages 60 - 80. They are more frequent in white people, the most common sites of diseases are the face or scalp and other areas of high sun exposure.

- **Meta-Analysis**
  - is where data from a number of studies are lumped together in order to provide evidence for or against a hypothesis.

- **Metastasis**
  - Where the cancer has spread to other parts of the body beyond the **primary** site. Metastatic sites (secondaries) my be regional or distant from the original tumour.
- **Monoclonal-Antibody**
  - An antibody produced in the laboratory that can target specific antigens (substances that provoke an immune response). They can be made in large quantities, and are being tested for their use in cancer/diagnosis/and/treatment.

- **Morbidity**
  - Any departure, subjective or objective, from a state of physiological or psychological well-being. In this sense, sickness, illness, and a morbid/condition

- **Mortality**
  - Looking at the death rates caused by a disease.
  - **Mortality rate:** Calculated by dividing the number of people who have died of a particular cancer during a given period of time by the total population at risk.

- **Multiple-Myeloma**
  - A cancer of the white blood cells found in the bone marrow.

- **Myelodysplasia**
  - Abnormal production and maturation of blood cells; often leading to deficiency of red cells, white cells and platelets; sometimes leading to bone marrow failure or leukemia.
- **Neoplasm**
  - A new growth of tissue serving no physiological function
- **Nephrotoxicity**
  - Some anti cancer drugs may have the side effect of damaging the kidneys, for example ifosfamide and cisplatin are known to be nephrotoxic. There are two categories; glomerular and tubular toxicity relating to the two main areas of the nephron. In studies of ifosfamide the degree of nephrotoxicity is thought to be related to the cumulative dose, but there is a good deal of variability between

patients.

- **Neuroblastoma**
  - Neuroblastoma occurs most often in babies, young children. It is a disease in which cancer cells are found in certain nerve cells in the body, it originates in the adrenal medulla or other sites of sympathetic nervous system tissue. The most common site is the abdomen, either in the adrenal glands or around the spinal cord. The majority of patients present with metastatic disease. Age and stage are the main prognostic factors. Patients aged under one year at diagnosis have a more favourable prognosis. Stage 4S are a special group of patients aged under one year whose neuroblastoma may undergo spontaneous regression (tumour disappears without treatment). Also patients aged under one a higher proportion of low stage patients compared to older patients. There is an excess of males compared to females, there are a higher proportion of males in patients with less favourable sites and stage.

- **Neutropenia**
  - below normal levels of leukocytes in the blood. Febrile-neutropenia (neutropenia with fever) is a common toxicity following chemotherapy.

- **Neutrophil**
  - Type of white blood cell; also called a poly; granulocyte; the body's primary defense against harmful bacteria.
- **Non-Hodgkin's-Lymphoma**
  - Any kind of cancer of the lymph tissues other than Hodgkin's disease
- **Oedema**
  - abnormally large amounts of fluid in the intercellular tissue spaces.
- **Oncologist**
  - A physician who, after extensive training, specializes in cancer treatment.

- **Oncology**
  - A science dealing with the physical, chemical, and biologic properties and features of cancer, including causes and the disease process.

- **Osteogenic Sarcoma**
  - Osteogenic Sarcoma (osteosarcoma) is a bone forming cancer. It is the most frequent type of bone tumour and is most common between the agesof 15 to 25. Over 90% of tumours are located in the metaphysis (the growing ends of the bone), the most common sites are the long bones of the legs. Most tumours are solitary, around 2% are multifocal (2 or more bones). It is known that osteosarcoma can be radiation induced. Osteosarcomas vary greatly in radiological and pathological features and therefore needs careful diagnosis to differentiate this from other bone tumours. Most are high grade intramedullary osteosarcomas, about 5% are low grade lesions, some are secondary osteosarcomas (for example those caused by radiationtherapy).

- **Osteomyelitis**
  - inflamation of bone - infection
- **Osteoporosis**
  - reduction in bone mass = prone to fractures
- **Paediatric-Oncology**
  - The branch of medicine which specialises in the study and treatment of childhood cancer. Treating children requires different considerations compared with adult oncology, for example potential treatment side effects may be different to those in adults. Because of the differences between childhood and adult cancers most children are treated in specialist paediatric oncology units, in the UK about 80% of children are treated at a UKCCSG centre.

AUTHOR ACHIEVMENTS :

Publications list:

Key publications published by the Author in "INTERNATIONAL JOURNALS"

- ✓ **DOOSLIN MERCY BAI AND S. KOUSIK SARAVANA (2022); EVALUATION AND QUANTITATIVE ANALYSIS OF BIOACTIVE COMPOUNDS FROM CHAETOCEROUS CALCITRANS AGAINST HUMAN PATHOGENS *INT. J. OF ADV. RES.*** 10 **(JUN). 309-321] (ISSN 2320-5407).**
- ✓ **DOOSLIN MERCY BAI AND S.**KOUSIK SARAVANA (2021);QUALITATIVE AND MICROBIAL ASSESSMENT OF NANNOCHOLOROPSIS OCCULATA AGAINST HUMAN PATHOGENS THROUGH GC-MS ANALYSIS IJSRED (ISSN:2581-7175)

THANK YOU 💝

NOTES

NOTES